SELECTED

SWATERRESOURCES ABSTRACTS



VOLUME 13, NUMBER 19 OCTOBER 1, 1980 SELECTED WATER RESOURCES ABSTRACTS (SWRA) is produced by the Office of Water Research and Technology, U.S. Department of the Interior, and published twice monthly by the National Technical Information Service (NTIS), U.S. Department of Commerce:

SWRA is available to Federal agencies and their contractors or grantees in water resources research upon request, citing contract or grant number and sponsoring agency. Write: Office of Water Research and Technology, U.S. Department of the Interior, Washington, DC 20240. The SWRA Journal is also available on subscription from NTIS, 5285 Port Royal Road, Springfield, VA 22161. Annual subscription rates for the North American Continent are: Journal only, \$75; Journal and Annual Indexes, \$100; Indexes only, \$50. Other addressees, write for prices.

Some documents abstracted in this journal can be purchased from NTIS. Price codes are given in the entries and a current code-price conversion table is printed on the outside back cover. Other documents are available from originating organizations or authors as indicated in the citation.

JMI

SELECTED WATER RESOURCES ABSTRACTS

A semimonthly publication of the Office of Water Research and Technology U.S. Department of the Interior



VOLUME 13, NUMBER 19 OCTOBER 1, 1980

W80-06001 -- W80-06200

The Secretary of the U.S. Department of the Interior has determined that the publication of the periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Director of the Office of Management and Budget through August 31, 1983.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most our our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

MI

FOREWORD

Selected Water Resources Abstracts, a semimonthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. The contents of these documents cover the water-related aspects of the life, physical, and social sciences as well as related engineering and legal aspects of the characteristics, conservation, control, use, or management of water. Each abstract includes a full bibliographic citation and a set of identifiers or descriptors which are listed in the Water Resources Thesaurus. Each abstract entry is classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the Federal Council for Science and Technology.

WRSIC IS NOT IN A POSITION TO PROVIDE COPIES OF DOCUMENTS ABSTRACTED IN THIS JOURNAL. Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several planned services of the Office of Water Research and Technology.

To provide SWRA with input, selected organizations with active water resources research programs are supported as "centers of competence" responsible for selecting, abstracting, and indexing from the current and earlier pertinent literature in specified subject areas.

The input from these Centers, and from the 54 Water Resources Research Institutes administered under the Water Research and Development Act of 1978, as well as input from the grantees and contractors of the Office of Water Research and Technology and other Federal water resource agencies becomes the information base from which this journal is derived.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Office of Water Research and Technology U.S. Department of the Interior Washington, D.C. 20240

CONTENTS

FOREW	/ORDili
SUBJE	CT FIELDS AND GROUPS
	Please use the edge index on the back cover to locate Subject Fields and Indexes.
01	NATURE OF WATER
0,	Includes the following Groups: Properties; Aqueous Solutions and Suspensions.
02	WATER CYCLE
-	Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.
03	WATER SUPPLY AUGMENTATION AND CONSERVATION
	Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.
04	WATER QUANTITY MANAGEMENT AND CONTROL
	Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.
05	WATER QUALITY MANAGEMENT AND PROTECTION
	Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.
06	WATER RESOURCES PLANNING
	Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.
07	RESOURCES DATA
	Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.
08	ENGINEERING WORKS
	Includes the following Groups: Structures; Hydraulics; Hydraulic Machinery; Soil Mechanics; Rock Mechanics and Geology; Concrete; Materials; Rapid Excavation; Fisheries Engineering.
09	MANPOWER, GRANTS, AND FACILITIES
	Includes the following Groups: Education—Extramural; Education—In-House; Research Facilities; Grants, Contracts, and Research Act Allotments.
10	SCIENTIFIC AND TECHNICAL INFORMATION
	Includes the following Groups: Acquisition and Processing; Reference and Retrieval; Secondary Publication and Distribution; Specialized Information Center Services; Translations; Preparation of Reviews.
	SUBJECT INDEX
	AUTHOR INDEX
	ORGANIZATIONAL INDEX
	ACCESSION NUMBER INDEX
	ABSTRACT SOURCES

МΙ

SELECTED WATER RESOURCES ABSTRACTS

1. NATURE OF WATER

1A. Properties

CHEMISTRY OF THE SPRING WATERS OF THE OUACHITA MOUNTAINS EXCLUDING HOT SPRINGS, ARKANSAS, Arkansas Water Resources Research Center, Fay-

G. H. Wagner, and K. F. Steele.

Available from the National Technical Information Service, Springfield, VA 22161 as PB80-203466, Price codes: A09 in paper copy, A01 in microfiche. Publication No 69, March 1980. 180 p, 41 Fig. 14

Tab, 39 Ref. OWRT B-055-ARK(1). 14-34-0001-8061

Descriptors: *Springs, *Wells, *Chemical analysis, *Mineralogy, Ions, Cations, Salts, Chemical precipitation, Metals, Silicates, Temperature, Groundwater, Hot springs, Arkansas, Photometry, Flame photometry, Water analysis, Water quality, A tomic absorption. photometry, Wat Atomic absorption.

Chemical analysis of the waters from 93 springs and 9 wells in the Ouachita Mountains (excluding Hot Springs), Arkansas, are reported. The study was carried out to investigate groundwater quality, its subsurface temperature, and its potential as a mineral pathfinder. The samples were collected and stored in clean polyethylene containers for SiO2, SO4, Cl; PO4, and NH3 analyses. Alkalimity, was repeature and conductivity was repeature. pH, temperature, and conductivity were measured at the site and raw water was filtered to remove any solid contaminants. Atomic absorption (AA) spectrophotometry, or flame emission were emspectrophotometry, or liame emission were em-ployed in the analyses of all cations in the acidified raw water. Springs with anomalously high tem-peratures, metal content, and high silica content are likely to indicate known, local mineralization. Threshold and anomalous concentrations of metals had to be determined for a specific area. Anoma-low converted transfer has a specific area. lous concentrations of a base metal in an individual spring indicates a mineral deposit within one mile in 41% of the cases. Barite mineralization was indicated by a high Ba concentration. High stron-tium concentrations were not found in springs near known Sr mineralizations and concentrations of Li and K gave no indication of nearby lithiophorite and cryptomelane. All tables and figures are given at the end of the report. (Sidney-IPA)

WATER QUALITY OF FLORIDA SPRINGS, Geological Survey, Tallahassee, FL. Water Re-

Geological Survey, Falanassee, F.L. Water Resources Div. L. J. Slack, and J. C. Rosenau. Florida Bureau of Geology Map Series 96, 1979. 1 Sheet, 3 Fig, 3 Tab, 7 Ref.

Descriptors: *Water quality, *Florida, *Maps, *Springs, *Groundwater, Discharge(Water), Water chemistry, *Floridan aquifer.

A major part of Florida's ground-water discharge is from about 300 springs. Estimated discharge is 8 billion gallons per day, or more than twice the quantity of water pumped for all uses in the State. The prevalent chemical types of water discharging from the major springs of Florida, in their order of importance are: calcium-magnesium bicarbonate, sodium chloride, a blend of two or more chemical types, and calcium sulfate. Based on available data, the chemical quality of the water is cancelled. the chemical quality of the water is generally ex-cellent and relatively constant with time although some springs may occasionally discharge organic brown water. (Kosco-USGS) W80_06058

2. WATER CYCLE

2A. General

CALIBRATION OF A DISTRIBUTED ROUTING RAINFALL-RUNOFF MODEL AT FOUR RUBAN SITES NEAR MIAMI, FLORIDA, Geological Survey, Bay St. Louis, MS. Water Resources Div. W. H. Doyle, and J. E. Miller. Geological Survey Water Resources Investigations 80-1, February 1980. 87 p, 29 Fig, 25 Tab, 18 Ref.

Descriptors: *Rainfall-runoff relationships, *Computer models, *Model studies, *Urban runoff, *Florida, Storm water, Urban hydrology, Flow characteristics, Soil moisture, Analytical techniques, Mathmatical models, *Miami(FL).

catchments were collected and compiled by the U.S. Geological Survey and were used for testing the applicability of deterministic modeling for the application of determinate modeling for characterizing stormwater flows from small land-use areas. A description of model calibration and verification is presented for: (1) A 40.8 acre single-family residential area, (2) a 58.3-acre highway area, (3) a 20.4-acre commercial area, and (4) a 14.7-acre multifamily residential area. Rainfall-runoff data for 80, 108, 114, and 52 storms at sites, 1, 2, 3, and 4, respectively, were collected, analyzed, and stored on direct-access files. Rainfall lyzed, and stored on direct-access files. Rainfall and runoff data for these storms (at 1-minute time intervals) were used in flow-modeling simulation analyses. A distributed routing Geological Survey rainfall-runoff model was used to determine rainfall excess and route overland and channel flows at each site. Optimization of soil-moisture-accounting and infiltration parameters was performed during the calibration phases. The results of this study showed that, with qualifications, an acceptable verification of the Geological Survey model can be achieved. (Kosco-USGS)

HYDROLOGY OF JUMPER CREEK CANAL BASIN, SUMPTER COUNTY, FLORIDA, Geological sources Div. cal Survey, Tallahassee, FL. Water Re-For primary bibliographic entry see Field 4A. W80-06063

OXIDATIVE POLYMERIZATION OF DIS-SOLVED PHENOLS BY SOLUBLE AND IN-SOLUBLE INORGANIC SPECIES, Academy of Natural Sciences of Philadelphia, Avondale, PA. Stroud Water Research Center. For primary bibliographic entry see Field 5A. W80-06113

STOCHASTIC PARAMETER ESTIMATION PROCEDURES FOR HYDROLOGIC RAIN-FALL-RUNOFF MODELS: CORROLATED AND HETEROSCEDASTIC ERROR CASES, Case Western Reserve Univ., Cleveland, OH. Dept. of Systems Engineering. S. Sorooshian, and J. A. Dracup. Water Resources Research, Vol 16, No 2, p 430-442, April 1980. 6 Fig. 6 Tab, 32 Ref. NSF ENG-77-11137.

Descriptors: *Rainfall-runoff relationships, *Model studies, *Mathematical models, Stochastic processes, Runoff, Rainfall, Precipitation(Atmospheric), Discharge(Water), Water levels, Stage-discharge relations, Flow, Streamflow, Hydrology, Errors, Rainfall-runoff models.

A maximum likelihood estimation procedure was presented through which two aspects of the streamflow measurement errors of the calibration phase were accounted for. First, the correlated error case was considered where a first-order autoregressive scheme was presupposed for the additional control of the co toregressive scheme was presupposed for the additive errors. This proposed procedure first determined the anticipated correlation coefficient of the errors and then used it in the objective function to estimate the best values of the model parameters. Second, the heteroscedastic error case (changing variance) was considered for which a weighting approach, using the concept of power transformation, was developed. The performances of the new procedures were tested with synthetic data for various error conditions on a two-narmeter. procedures were tested with synthetic data for various error conditions on a two-parameter model. In comparison with the simple least squares criterion and the weighted least squares scheme of the HEC-1 of the U.S. Army Corps of Engineers for the heteroscedastic case, the new procedures constantly produced better estimates. The procedures were found to be easy to implement with no convergence problem. In the absence of correlated errors, as theoretically expected, the correlated error procedure produces the exact same estimates as the simple legst converge criticals. Libraria, Libraria. as the simple least squares criterion. Likewise, the self-correcting ability of the heteroscedastic error procedure was effective in reducing the objective function to that of the simple least squares as data gradually became homoscedastic. Finally, the effective residual tests for detection of the abovementioned error situations were discussed. (Simstepped procedure) ISWS) W80-06138

A STOCHASTIC-CONCEPTUAL ANALYSIS OF RAINFALL-RUNOFF HILLSLOPE, PROCESSES

British Columbia Univ., Vancouver. Dept. of Geological Sciences. For primary bibliographic entry see Field 2E. W80-06140

A FREQUENCY DISTRIBUTION FOR ANNUAL FLOODS, Griffith Univ, Nathan (Australia). School of Australian Environmental Studies. For primary bibliographic entry see Field 2E. W80-06152

SOME PARADOXES IN THE HISTORY OF HYDRAULICS.

Iowa Univ., Iowa City. H. Rouse.

Journal of the Hydraulics Division, American Society of Civil Engineers, Vol 106, No HY6, Proceedings Paper 15475, p 1077-1084, June 1980.

Descriptors: *Flow resistance, *Flow system, *Flow, History, Hydraulics, Roughness (Hydraulic), Resistance, Roughness coefficient, Hydrodynamics, Cavitation, *Resistance coefficients, Hydraulics history, Roughness, Paradose Archimedes Aristotle doxes, Archimedes, Aristotle.

Successive instances in the development of hydrau-lics were cited in which conditions were not as they were generally assumed to have been. Emphasis was laid upon problems of fluid resistance, beginning with Nature's 'abhorrence of a vacuum' at the time of Aristotle and extending to the relative-roughness diagrams of the very recent past. Much of the material was published first in 1957, in 'History of Hydraulics', and later in 1976, in 'Hydraulics in the United States'. (Roberts-ISWS) W80-06192

2B. Precipitation

ON SOME ASPECTS OF CLIMATOLOGY AS-SOCIATED WITH A DAM, Witwatersrand Univ., Johannesburg (South Africa). T. G. J. Dyer.

Water SA, Pretoria Vol 4 No 3, p 113-118, 1978. 7 fig, 11 ref.

Descriptors: *Climatology, *Rainfall, *Inflow, *Mathematical stuies, *Fluctuations, *Dam construction, Evaporation, Transpiration, Evapotraspiration, Wavelenghts, Forecasting, Economic prediction, Future planning(Projected), Regression analysis, Time series analysis, Frequency analysis, Hydrology, South Africa.

The behavior of spatial mean rainfall series in Gaborone, South Africa, was investigated in order to perdict the best year in which to build a new dam. Suitable mathematical analysis of rainfall data would give estimates for rainfall and dam inflow for the future including the patterns of negative and positive anomalies. A new approach, the time series analysis, was employed using harmonic analysis containing adjustments for pseudo-peridodic oscillations. The width of the wave band can be tested for significance and the preciseness of a tested for significance and the preciseness of a wave length can also be found. The rainfall in the local dam area was analyzed for the period 1909/

Group 2B—Precipitation

10 to 1975/6. Oscillations with long wave lengths were absent and there was a strong ten year wave for the series of annual inflow totals. Variances in the fit of the data to a trigonometric regression expression were accounted for by extreme vales in the data. The estimated series for inflow and rainfall were smoothed using a five term binomial filter. It was suggested from the data that the dam should be built during the period of positive rainfall anomalies over the interval 1980/90. (Sidney-IPA) w80-06071

PRELIMINARY CLOUD MICROPHYSICS STUDIES FOR TEXAS HIPLEX 1979, Texas A and M Univ., College Station. Dept. of Meteorology.

A. B. Long.
Report No LP-124 prepared for Texas Department
of Water Resources, Austin, TX March 1980. 82 p.
15 Fig. 10 Tab, 2 Ref, 1 Append. 14-06-D-7587.

Descriptors: *Cloud physics, *Chemistry of precipitation, *Precipitation(Atmospheric), *Clouds, *Storm structure, Climatology, Meteorology, Atmospheric physics, Weather data, Texas, On-site data collection, Aircraft, Instrumentation, Data processing, Dew point, Air temperature.

Initial cloud microphysis studies by Texas A and M University of the important precipitation mechanisms is convective clouds in the Texas HIPLEX region are reported. The data collected will be used to test rain enhancement techniques for this specific type of cloud. A fully instrumented aircraft collected the data in the field during the period, May 21 to July 20, 1979. The thermodynamic, kinematic, and micro-phyical properties were evaluated and the data were recorded on magnetic tape for further evaluation. Clouds suitable for microphysical studies were selected by a specific set of rules. Certain microphysical parameters must be met for a cloud to be selected when the aircraft makes an initial pass through the cloud. About half of the clouds met the selection rules and those which did not, had tops which were too cold, initial ice particle concentration was too high, or precipitation had already begun. Analysis of the data showed that as precipitation falls through subcloud air its temperature is decreased and dew point increased. This may be an example o the wet-bulb process operating within subcloud air or it may indicate penetration of potentially downdraft air into the subcloud region. Of the clouds studied, it was concluded that the ice process was necessary for significant precipitation to occur. (Sidney-IPA)

DRAFT, CONSTRUCTION AND OPERATION OF A SEQUENTIAL RAIN SAMPLER, Utrecht Rijksuniversiteit (Netherlands). Inst. voor Meteorologie en Oceanografie. For primary bibliographic entry see Field 7B. W80-06084

RAIN DROP SIZES AND RAINFALL RATE
MEASURED BY DUAL-POLARIZATION
RADAR,
Ruthford and Appleton Lab. Slough (England)

RADAR, Ruthrford and Appleton Lab., Slough (England). For primary bibliographic entry see Field 7B. W80-06087

DIURNAL RAINFALL VARIATION IN NORTHEAST BRAZIL,
Conselho Nacional de Desenvolvinento Científico e Technologico, Rio de Janeiro (Brazil); and Instituto de Pesquisas Espaciais, Sao Jose dos Campso (Brazil).

V. E. Kousky. Monthly Weather Review, Vol 108, No 4, p 488-498, April 1980. 10 Fig. 1 Tab, 12 Ref.

JMI

Descriptors: *Rainfall, *Diurnal, *Coasts, Coastal plains, Diurnal distribution, Nocturnal, Winds, Sea breezes, Temperature, Precipitation, Areal, *Brazil, *Diurnal rainfall, *Northeast Brazil, *Amazon River, Rainfal variation, Convergence, Onshore flow, Offshore land breeze.

The diurnal rainfall variation in northeast Brazil was investigated for the period 1961-1970. Most coastal areas were found to experience a nocturnal maximum in rainfall activity, probably due to convergence between the mean onshore flow and the offshore land breeze. Areas 100-300 km inland experience a daytime maximum, associated with the development and inland advance of the sea breeze. The diurnal rainfall variability, at most interior locations, seems to be due to mountainalley breezes. Seasonal variations are noted for areas of the north coast of Brazil. Source, Located near the moth of the Amazon river, experiences a nocturnal maximum between June and September. Evidence was presented that shows that this seasonal variation is linked to the seasonal variation in the low-level mean flow. Seasonal variations in the mean monthly rainfall for coastal afteas was shown to correlate well with the intensity of the land breeze, which was represented by the difference between the mean sea surface temperature and the mean air temperature over land. (Roberts-ISWS)

THE NATURE OF RAINFALL FLUCTU-ATIONS IN SUBTROPICAL WEST AFRICA, National Center for Atmospheric Research, Boulder, CO. S. E. Nicholson.

Monthly Weather Review, Vol 108, No 4, p 473-487, April 1980. 11 Fig. 3 Tab, 29 Ref. NSF ATM77-21547, GA-10651.

Descriptors: *Rainfal, *Fluctuations, *Variability, *Africa, Droughts, Arid climates, Semiarid climates, Arid lands, Subtropic, Data processing, Correlation analysis, Precipitation(Atmospheric), Weather, Climatology, Meteorology.

The nature of rainfall fluctuations in the West African subtropics was described on the basis of three analyses of rainfall departures. Areally averaged, normalized rainfall departure seris for the years 1901-75 were derived for four semi-arid subsharan climatic zones: the Sahelo-Saharan, the Sahel, the Soudan, and the Soudano-Guinean. Similar series were derived for four or five regions within each zone, and the regional series were intercorrelated. Finally, correlation between annual rainfall departure maps was used to determine frequently occurring rainfall anomaly types. Several characteristics of West African climate variation emerged from these investigations. A strong coherence of variation occurred throughout the region from approximetly 20 - 10 deg N, a latitude which frequently marks a climatic discontinuity with large departures of opposite sign prevailing to the north and south, this coherence was very pronounced in both the north-south and east-west directions, although certain longitudinal sectors occasionally behave differently from the rest of the zone. Such a case resulted in a mixed configuration of drought, with negative anomalies prevailing only within certain sectors. The determined rainfall anomaly types represented several drought types for the Sahel, characterized by their various relations to conditions elsewhere on the continent. In general, rainfall fluctuations in the West African subtropics were more commonly characterized by a contraction or expansion of the Gesert belt, rather than by its north-south displacement. (Sims-ISWS)

EFFECTS OF CHEMICAL DEFOLIATION OF AN ABIES GRANDIS HABITAT ON AMOUNTS AND CHEMISTRY OF THROUGHFALL AND STEMFLOW,

STEMFLOW,
Pacific Northwest Forest and Range Experiment
Station, Wenatchee, WA.
A. R. Tiedemann, J. D. Helvey, and T. D.

Anderson.
Journal of Environmental Quality, Vol 9, No 2, p 320-328, April-June 1980. 4 Fig. 5 Tab, 31 Ref.

Descriptors: *Forests, *Chemistry of precipitation, *Nutrients, *Interception, Trees, Fir trees, Grand fir trees, Defoliants, On-site investigations, Throughfall, Stemflow, Water chemistry, Forestry, Water pollution sources, *Defoliation effects.

Amounts and chemistry of gross precipitation, throughfall, and stemflow were measured before and after chemical defoliation of a coniferous forest stand in eastern Washington. Throughfall (T) in the natural stand was related to gross precipitation (P) be the equation T = 0.842P · 0.182 with a coefficient of determination (R sq) of 0.972. Throughfall and stemflow increased significantly after defoliation, but the actual amounts were small. Cross precipitation before defoliation contained 0.47 mg/liter total nitrogen (T-N), 0.06 mg/liter total phosphorus (T-P), ando) Tmg/liter total cations (Ca, Mg, Na, and K). Total inputs between 24 August 1975 and I June 1976, were 0.84, 0.07, and 0.90 kg/hs for T-N, T-P, and total cations, respectively. Approximately 80% of the total annual precipitation was normally received during the period sampled. Concentrations of chemical constituents were increased up to 15 times in throughfall and up to 48 times in stemflow compared to gross precipitation. Ratios of nutrient delivery (Kg/ha) before defoliation as gross precipitation/throughfall/stemflow were 1.00-1.01:0.02 for T-N, 1.00:3.78-0.15 for T-P, and 1.00:7.57;0.20 for total cations. Defoliation reduced concentration of amnonium-N and increased concentration of amnonium-N and increased concentration of amnonium-N and increased concentration of summer with winter storms and treased amounts of throughfall and stemflow. Comparisons of summer with winter storms and try fallout with precipitation indicated that: (1) T-P and K are of local origin; (2) N probably originates from passage of air masses over urban and industrial areas, automobile exhaust, and agriculture (fertilization); and (3) Na and Mg are of marine origin. (Sims-ISWS) W80-06103

STOCHASTIC PARAMETER ESTIMATION PROCEDURES FOR HYDROLOGIC RAINFALL-RUNOFF MODELS: CORROLATED AND HETEROSCEDASTIC ERROR CASES, Case Western Reserve Univ., Cleveland, OH. Dept. of Systems Engineering. For primary bibliographic entry see Field 2A. W80-06138

ON THE STATISTICAL CHARACTERISTICS OF DROUGHT EVENTS, California Univ., Los Angeles. School of Engineering and Applied Science.
J. A. Dracup, K. S. Lee, and E. G. Paulson, Jr. Water Resources Research, Vol 16, No 2, p 289-296, April 1980. 6 Fig, 4 Tab, 9 Ref. NSF ENG77-11137.

Descriptors: *Droughts, *Streamflow, *Precipitation(Atmospheric), *Model studies, Runoff, Rainfall, Rivers, Low flow, Low-flow frequency, Correlation analysis, Hydrologic data, Climatology.

Several statistical tests were performed on streamflow series for purposes of analyzing multiyear drought events. These statistical tests on both highflow and drought event parameters included: (1) andomness in terms of lag-1 serial correlation; (3) correlation and cross correlation between these parameters (duration, magnitude, and severity. The test results and their implications were discussed in relation with the characterization of high-flow and drought event series. Two types of envelopes for drought duration and severity were presented that use Tschebycheff's inequality. These envelopes give an excellent indication of the maximum response of a watershed in terms of drought duration and severity during the period of record. (Sims-ISWS)

ON THE DEFINITION OF DROUGHTS, California Univ., Los Angeles. School of Engineering and Applied Science. J. A. Dracup, K. S. Lee, and E. G. Paulson, Jr. Water Resources Research, Vol 16, No 2, p 297-302, April 1980. 2 Fig. 1 Tab, 18 Ref. NSF

Snow, Ice, and Frost-Group 2C

ENG77-11137.

Descriptors: *Droughts, *Streamflow, *Soil moisture, *Precipitation(Atmospheric), Analytical techniques, Data processing, Rainfall, Runoff, Low flow, Low-flow frequency, Time series analysis, Hydrologic data, Climatology, Meteorology, Hydrology, Drought definition.

Several considerations for developing a practical, analytical definition of droughts were discussed. These considerations included: (1) selection of the nature of the water deficit to be studied (hydrological, meteorological, or agricultural); (2) selection of the averaging period used to discretize a continuous time series (months, seasons, or years); (3) selection of the truncation level used to separate droughts from the remainder of the tring-agricultural programmes of the tring-agri selection of the truncation level used to separate droughts from the remainder of the time series (mean or median); and (4) method of regionalization or standardization. These decisions were discussed in terms of their impacts on various approaches to drought frequency analysis. Drought events were considered to be composed of duration, magnitude (average water deficiency), and severity (cumulative water deficiency). An application of the proposed drought definition procedure was presented for the case of a frequency analysis of multiyear hydrologic droughts. (Sims-ISWS) ISWS) W80-06148

EROSIVITY VALUES FOR INDIVIDUAL

DESIGN STORMS,
Science and Education Administration, Boise, ID.
For primary bibliographic entry see Field 2J.

2C. Snow, Ice, and Frost

PERFORMANE OF V.H.F. AERIALS CLOSE TO A SNOW SURFACE,

TO A SNOW SURFACE, British Antarctic Survey, Cambridge (England). C. S. M. Doake, and M. Gorman. Journal of Glaciology, Vol 22, No 88, p 551-553, 1979. I Fig. 1 Tab, 3 Ref, 1 Append.

Descriptors: *Sounding, *Ice, *Antennas, *Instrumentation, Radar, Surfaces, Snow, Foreign research, Foreign countries, Electrical impedance, Frequency, Masurement, On-site investigations, Standing waves, V.H.F., Voltage standing-wave ratio.

Measurements of aerial admittance as a function of recessurements or aerial admittance as a function of height above a snow surface show that when the surface temperature is below freezing, the aerial performane is insensitie to slight surface irregularities. (Humphreys-ISWS) W80-06098

A RECOMMENDATION FOR THE APPLICA-TION OF THE ROCH INDEX FOR SLAB AVA-LANCHE RELEASE,

LANCHE RELEASE, Rocky Mountan Forest and Range Experiment Station, Fort Collins, CO. R. A. Summerfeld, and R. M. King. Journal of Glaciology, Vol 22, No 88, p 547-549, 1979. 1 Tab, 7 Ref.

Descriptors: *Avalanches, *snow management, *Slope stability, *Forecasting, Movement, On-site investigatins, Snowpacks, Shear, Analysis, On-site data collections, Slabs, Snow.

Detailed measurements on several avalanches verify that a Daniels' type statistical correction to roch's stability index would accurately predict snow-slope instability. It was recommended that one-half the median of at least 50 shear-strength masurements be used as a measure of the strength of a weak layer. (Humphreys-ISWS)

'SAW-TOOTH' MORAINES IN FRONT OF BO-DALSBREEN, SOUTHERN NORWAY, University Coll., Cardiff (Wales). Dept. of Geology. J. A. Matthews, R. Cornish, and R. A. Shakesby.

Journal of Glaciology, Vol 22, No 88, p 535-546, 1979. 6 Fig, 3 Tab, 39 Ref.

Descriptors: *Glaciology, *Glacial drift, *Topography, *Geomorphology, Shape, On-site investigations, Profiles, Surveys, Measurement, Lichens, Analysis, Foreign countries, *Norway, Glacier Bodalsbreen, Saw-tooth profile.

A series of end moraines, with a remarkable saw-tooth pattern, were reported from the glacier fore-land of Bodalsbreen, a northern outlet of the ice cap Jostedalsbreen. The three-dimensional morphology of the moraines was described and analyzed. Historical records and lichenometric measurements indicate that they were deposited after the Little Ice Age glacier maximum of the mid-eighteenth century. It was inferred that the local topography of Bodalen was conducive to the fortopography of bodaten was conducive to the for-mation of a heavily crevassed pecten at the snout of Bodalsbreen, which produced the end moraines by a push mechanism during minor glacier ad-vances. The observations suggest that pushing may be an underestimated mechanism in moraine ridge formation generally. (Humphreys-ISWS) W80-06100

FORCES ON STRUCTURES IMPACTED AND ENVELOPED BY AVALANCHES,

Boeing Co., Seattle, WA. R. R. Pedersen, J. D. Dent, and T. E. Lang. Journal of Glaciology, Vol 22, No 88, p 529-534, 1979. 5 Fig. 4 Ref, 1 Append.

Descriptors: *Avalanches, *Loads(Forces), *Structures, *Model studies, *Snow management, Forecasting, Compute models, Snow, Velocity, Methodology, Analytica techniques, Analysic, Shear, Load distribution, Flow, Pressure, Impact

A computer code was reported that models two-dimensional flow of a snow-avalanche cross-section over a down-slope structure of arbitrary crosstion over a down-stope structure of arbitrary cross-sectional shape. Impact forces and pressure are predicted, and the flow pattern past the structure may be arrayed pictorially. The model was applied may be arrayed pictoriany. In e model was applied to the prediction of forces on rectangular obstacles that are of fractional height to the nominal avalanche flow depth for avalanche flow speeds up to 20 m/s. The program was applied to modeling an experiment by Salm of impact of snow blocks upon a slope-normal wall in order to demonstrate the accuracy of the code in comparison to impact-force histories measured by Salm. Difference between the experimental results and the computer simulation was less than 21%, and supporting discussion was given on factors that may account for the difference. (Humphreys-ISWS) W80-06101

TIME-SERIES MODELLING OF AVALANCHE ACTIVITY FROM METEOROLOGICAL DATA, National Research Council of Canada, Vancouver (British Columbia). Div. of Builiding Research. A. A. Salway.

Journal of Glaciology, Vol 22, No 88, p 513-528, 1979. 3 Fig, 3 Tab, 18 Ref.

Descriptors: *Avalanches, *Snow management, *Model studies, *Forecasting, Time series analysis, On-site investigations, Mathematical models, Meteorological data, Analytical techniques, Statistical methods, Hazards, *British Columbia, *Rogers Pass(B.C.).

Avalanche-hazard evaluation by field analysts is largely achieved along causal intuitive lines depending for its success upon the experience of the analyst in his particular area. Several attempts have been made in the past to quantify such procedures by means of statistical models based upon meteorological measurements. Modified forms of a multivariate technique known as linear discriminant analysis have been tried with only partial success. Intercorrelated variables and autocorrelated data, omission of time-lagged terms, insufficient variation in the dependent variable, and sampling difficulties may have combined to weaken the discriminant approach. These problems and the nature of the phenomenon suggest that a stochastic transfer-

function time-series approach may be a useful alternative method. A numerical weighting scheme has been devised for the representation of avalanche activity for the Rogers Pass area of British Columbia in terms of terminus, size, and moisturecontent codes for each event. From various types of correlation analysis performed on data for the period 1965-73, models were developed using the 'best' weighting scheme for avalanche activity representation and the most promising meteorological variables as indicated by the results of the correla-tion analysis. These relatively simple models dem-onstrated a good fit to the actual data in both a descriptive and a simulated-forecasting situation. (Humphreys-ISWS) W80-06102

EVALUATION OF JET-ROOF GEOMETRY FOR SNOW-CORNICE CONTROL,

Montana State Univ., Bozeman. Dept. of Civil Engineering and Engineering Mechanics.

Journal of Glaciology, Vol 22, No 88, p 503-511, 1979. 8 Fig, 1 Tab, 9 Ref.

scriptors: *Snow cornice, *Snow management *Model studies, *Slope protection, Flow around objects, Snow, Shape, Jets, Mathematical models, Slopes, Mountains, Distribution, Spatial distribution, Scour, Flow, Hydrodynamics, Eddies, Analytical techniques, Jet-roof geometry, Snow deposition, Mountain ridges.

Numerical hydrodynamic simulation of the jet-roof geometry for control of snow deposition to prevent cornice formation at mountain ridges was reported. Different jet-roof geometries were evaluated based upon the extent and size of the ground-the settention and the recipulation. surface stagnation region and the recirculation region to the lee of the roof. Results show that jetroof length should be of the same order as nominal height of the roof from the ground surface. Efficient placement of the roof was shown to be that with the leading edge directly above the mountain ridge, and roof angle approximately equal to lee slope angle. In numerical simulation of flow-field start-up, near steady-state flow is approched in less than 1.0 s real time indicating short transient-flow duration. (Humphreys-ISWS) W80-06103

AN ANALYSIS OF THE IN-SITU RESISTIVITY OF SEA ICE IN TERMS OF ITS MICROSTRUCTURE,

National Research Council, Ottawa (Ontario). Div. of Mechanical Engineering. G. W. Timco.

Journal of Glaciology, Vol 22, No 88, p 461-471, 1979. 5 Fig, 2 Tab, 24 Ref.

Descriptors: *Ice, *Resistivity, *Sea ice, *Electrical properties, On-site tests, Direct currents, Sounding, Physical properties, Analytical techniques, Analysis, On-site investigations, Measurement, Structure, Anisotropy, Isotropy, *In-situ resistivity, Geoelectric soundings, Microstructure, Brine cells.

The results of 66 Schlumberger geoelectric soundings on first-year sea ice were analyzed to obtain average values of d.c. electrical resistivity both parallel rho sub 1 and perpendicular rho sub p to he long brine cell direction. This analysis yielded rho sub 1 = 104 omega m, 80 omega m, 45 omega m, and rho sub p = 298 omega m, 230 omega m, 129 omega m for brine volumes v sub b of 0.040, 0.067, and 0.082, respectively. The observed de-pendence of rho sub 1 on v sub b is used in conjunction with a mixing formula for the electri-cal resistivity of a two-phase heterogeneous system to arrive at values of 'average' brine cell lengths 1 for relatively warm sea ice. This treatment yields 1 for relatively warm sea i.e. I his treatment yields about 1.7 cm for 0.040 less than or equal to v sub b less than or equal to 0.070 with a rapid extension of brine cell lengths for brine volumes above c. 0.070. (Humphreys-ISWS)
W80-06104

Group 2D—Evaporation and Transpiration

2D. Evaporation and Transpiration

MAPPING POTENTIAL EVAPOTRANSPIRATION IN HILLY TERRAIN, Natal Univ. Pietermaritzburg (South Afria.) R. E. Schulze. South African Geographical Journal, Vol 57 No 1, p 26-35, 1975. 4 Fig. 2 Tab, 25 Ref.

Descriptors: *Evapotranspiration, *Solar radiation, *Energy buget, *Climatology, *Topography, Ter-rain analysis, Mapping, Slopes, Transpiration loss, Hydrologic cycle, Watersheds(Basins), Grasslands, Spatial distribution, Seasonal, Computers, Math-ematical studies, Data processing, Summer, Autum, Winter, *South Africa.

The relationsip between solar energy exposure of sloping terrain and the water loss due to evapotranspiration is discussed. Map of the potential resportanspiration (PE) of four of the hydrological research catchments at Cathedral Peak, South Africa, were developed using climatological data collected during midsummer, midseason, and midwinter. Daily potential evapotranspiration was only about 8 mm during midsummer (December 22) and it differed only slightly with the value of daily incoming radiation. The shaded western slopes indicated lower potential water losses. Midsearch (2008) 137 was show greater streams of the shade was the same of the shade western slopes indicated lower potential water losses. Midsearch (2008) 137 was show greater streams. slopes indicated lower potential water losses. Midseason (March 22) maps show greater exposure
and water loss (7 mm) on the steeper western
slopes and the effects of north/south sloping are
very pronounced. Discrepancies between the radiation and PE (between 3 to 5 mm) were evident
during midwinter (June 21). The intercatchment
variations depend on the north/south sloping, Berg
Wind conditions, and clould cover. In summer the
Catchments vary in PE by conly 5 (3% in the coultin-Catchments vary in PE by only 5.8% in the equinoxes, 16.9%, and in midwinter by 42.5%. These data can be used to develop programs to minimize water loss by evapotranspiration and reduce South Africa's large water budget. (Sidney-IPA)

2E. Streamflow and Runoff

FLOOD OF JULY 5-7, 1978, ON THE SOUTH FORK ZUMBRO RIVER AT ROCHESTER, MINNESOTA,

Geological Survey, St. Paul, MN. Water Resources Div. V. J. Latkovich.

Available from OFSS, Box 25425, Fed. Ctr. Denver, CO. 80225. Paper copy \$3.50, microfiche \$0.50. Geological Survey open-file report 79-1583 (WRI), 1979. 1 Sheet, 4 Fig. 2 Ref.

Descriptors: *Floods, *River flow, *Minnesota, *Thunderstorms, *Peak discharge, Flash floods, Flood damage, Flood recurrence interval, Flood frequency, Historic floods, Flood data, Aerial photography, *South Fork Zumbro River(MN), *Richester(MN).

The intense thunderstorm of July 5-6, 1978, caused record flooding on the South Fork Zumbro River at Rochester, Minnesota. The peak discharge on July 6 was 30,500 cubic feet per second compared with 19,600 cubic feet per second for the flood of March 1965, which was the largest previously known. The 1965 flood had a recurrence interval of about 30 years, whereas the 1978 flood had a recurrence interval exceeding 100 years. The flood waters claimed at least 5 lives and 5,000 people were forced to leave their homes. Millions of dol. were forced to leave their homes. Millions of dolwere forced to leave their nomes. Millions of doi-lars in flood damage was reported, and this report summarizes some of the flood data and a photomo-saic map shows the inundated area. (Kosco-USGS) W80-06053

REGIONAL FLOOD-FREQUENCY RELA-TIONS FOR WEST CENTRAL FLORIDA,
Geological Survey, Tallahasse, FL. Water Re-Div.

M. A. Seijo, R. F. Giovannelli, and J. F. Turner.

JMI

Available from the OFSS Box 25425, Fed. Ctr. Denver Co 80225, paper copy \$9.75, microfiche \$4.50. Geological Survey open-file report 79-1293

(WRI), 1979, 41 p, 7 Fig, 7 Tab, 28 Ref.

Descriptors: *Flood frequency, *Florida, *Regional analysis, *Streamflow, *Flood forecasting, Flood profiles, Flood recurrence interval, Peak discharge, Watersheds(Basins), Drainage area, Reression analysis, Methodology, Hydrologic data, West-central Florida.

This report presents regional relations for estimating the magnitude and frequency of floods on streams in west-central Florida. Flood prediction equations derived cover 20, 5-, 25-, 100-, 200-, and 500-year recurrence intervals. Annual floods for three geographic areas of west-central Florida were found to relate significantly to basin characteristics. Basin characteristics include drainage area, soils index, slope, and lake area. The average standard error of estimate for regional flood relans ranged from 38.4 to 52.1 percent with a mean tions ranged from 38.4 to 32.1 percent with a mean of 43.5 percent. The average multiple correlation coefficient if 0.94. Regional relations apply to gaged and ungaged sites whose drainage areas are greater than 10 but less than 2,500 square miles. Tables of maximum known floods for 64 streamflow stations used in the analysis are included. Tables comparing station, weighted, and regional flood-peak discharges are also included. (Kosco-USGS) W80-06064

THE RESPONSE OF ILLINOIS MUNICIPAL WATER SYSTEMS TO A PROLONGED PERIOD OF DROUGHT, Illinois Univ. at Urbana-Champaign. Dept. of Ag-

ricultural Econo J. C. van Es, L. C. Keasler, and R. L.

J. C. Van Es, L. C. Keasier, and R. L. Whittenbarger. Available from the National Technical Information Service, Springfield, VA 22161 as PB80-204563, Price codes: A05 in paper copy, A01 in microfiche. Water Resources Center University of Illinois Research Report 152. June 1980, 82 p. J. Fig., 20 Tab, Append. OWRT A-090-ILL(1). 14-31-0001-8015.

Descriptors: *Water shortage, *Droughts, *Municipal water, *Illinois, Water management(Applied), Water supply, Local planning, Urban water management, Illinois municipal water systems.

The research evaluates the impact of the 1976-77 extended periods of shortage of rainfall on Illinois municipal systems. Excluded from the analysis were water systems in the suburban areas of large metropolitan cities. The data were obtained through questionnaires sent to the mayors and water systems operators. The questionnaires were followed by phone and personal interviews in some cases. The survey indicates that prior to the drought those municipalities affected by it were more likely to have smaller water systems, show a smaller margin between daily rated capacity and maximum daily usage, and rely more heavily on surface water sources. There is no evidence that the municipalities which subsequently experienced the drought were significantly and systematically less well managed than the municipalities which did not experience the drought. Municipalities affected by the drought made efforts to increase the supply of available water and decrease demands for available water. Few municipalities succeeded in obtaining water from other sources; it was either too expensive or unavailable. Those municipalities which were not directly affected by the drought which were not directly affected by the drought, however, frequently made changes in the way their water systems operate. Municipalities affected by the drought, however, frequently made changes in the water system operations which continued in effect beyond the end of the drought and which, in some cases, were not instituted until after the drought had subsided. W80-06079

STABLE ALLUVIAL CANAL DESIGN, San Diego State Univ., CA. Dept. of Civil Engi-

H. H. Chang.
Journal of the Hydraulics Division, American Society of Civil Engineers, Vol 106, No HY5, Proceedings Paper 15420, p 873-891, May 1980. 11 Fig, 1 Tab, 20 Ref, 2 Append.

Descriptors: *Canals, *Channels, *Sedimentation, Sediment transport, Computer models, Regime, River flow, Hydraulics, Alluvial channels, Canal design, Model studies, Alluvial canals, Stable

The hypothesis of minimum stream power for stable alluvial channels was used to derive a condistable alluvial channels was used to derive a condi-tion for alluvial channels in equilibrium. A method incorporating this condition with a flow-resistance formula and a sediment-discharge formula was de-veloped to compute the width, depth, and slope of stable alluvial channels for a given set of water and sediment discharges. Applying this method yielded a design chart that provides the stable width and depth of alluvial canals with trapezoidal shape for a given set of water discharge, channel slope. a given set of water discharge, channel slope, sediment size, and side slope. Comparing data from some regime canals and small experimental canals showed good agreement between the observed data and analytical predictions. (Lee-ISWS)

RUNOFF SYNTHESIS USING LANDSAT AND SCS MODEI

Maryland Univ., College Park. Dept. of Civil En-

May Jana Chry, College gineering. R. M. Ragan, and T. J. Jackson. Journal of the Hydraulics Division, American So-ciety of Civil Engineers, Vol 106, No HY5, Pro-ceedings Paper 15387, p 667-678, May 1980. 2 Fig, 7 Tab, 9 Ref, 2 Append.

Descriptors: *Hydrology, *Model studies, *Urban runoff, *Remote sensing, Surface waters, Runoff, Land use, Urbanization, Data collections, *Runoff synthesis, Landsat, SCS model, Landsat digital

The land cover requirements of the Soil Conserva-tion Service (SCS) model used to develop volume tion Service (SCS) model used to develop volume of runoff for hydrograph synthesis in suburban areas were modified to be compatible with Landsat digital data. Curve numbers obtained with these alternate land cover categories compared well with those obtained in published example problems using conventional categories. Synthetic flood frequency relationships computed for a test watershed showed that the conventional approach based on aerial photos agreed well with the Landset. on aerial photos agreed well with the Landsat-based approach to land cover determination. (Lee-ISWS) W80-06131

STOCHASTIC PARAMETER ESTIMATION PROCEDURES FOR HYDROLOGIC RAINFALL-RUNOFF MODELS: CORROLATED AND HETEROSCEDASTIC ERROR CASES, Case Western Reserve Univ., Cleveland, OH. Dept. of Systems Engineering.
For primary bibliographic entry see Field 2A.
W80-06138

A STOCHASTIC-CONCEPTUAL ANALYSIS OF RAINFALL-RUNOFF PROCESSES ON A HILLSLOPE,
British Columbia Univ., Vancouver. Dept. of Geo-

logical Sciences. R. A. Freeze.

Water Resources Research, Vol 16, No 2, p 391-408, April 1980. 18 Fig, 3 Tab, 37 Ref.

Descriptors: *Rainfall, *Runoff, *Slopes, *Model studies, Mathematical models, Stochastic processes, Monte Carlo method, Hydraulic properties, Hydraulic conductivity, Rainfall-runoff relationships, Precipitation(Atmospheric), Overland flow, Infiltration, Hydraulics, Hydrology, Analytical techniques, Hillslopes, Runoff processes, Hydrolo-

A stochastic-conceptual mathematical model of hydrologic processes on a hillslope was utilized to investigate the influence of the spatial stochastic properties of the hillslope parameters on the statistical properties of the resulting runoff events. The model utilized a stochastic rainfall generator and allowed the generation of overland flow by both the Horton mechanism and the Dunne mechanism. Streamflow statistics were determined on the basis Streamflow statistics were determined on the basis

Groundwater—Group 2F

of an event-based Monte Carlo simulation. The simulated hillslope runoff events were individually and statistically representative of actual runoff events reported in the literature from experimental watersheds. Results indicated that each of the parameters representing the spatial stochastic properties of the hydraulic conductivity distribution on a hillslope exerts an important influence on the statistical properties of most properties of support and properties of support and properties of support and properties of support properties of suppo tical properties of runoff events arising from a hillslope under a given climatic regime. The mean value is the most important parameter; the standard deviation is quite important; the autocorrelaand deviation is the least important. If one tries to represent a heterogeneous hillslope by an 'equiva-lent' homogeneous hillslope, the statistical proper-ties of the predicted runoff generated from a given stochastic sequence of storm events may be greatly in error. Results of the simulations reported in this paper suggest that the distribution of hydraulic conductivities over a watershed should be included conductivities over a watersned should be included in parametric representations of the unit hydrograph, in conceptual predictions of flood exceedance probabilities, and in physically based assessments of the autocorrelation structure of the streamflow sequences. Results of this study also infer a close relationship between climate, hydraulic conductivity, and geomorphic landform development. (Sims-ISWS) W80-06140

OPTIMAL OPERATION OF MULTIRESER-VOIR POWER SYSTEMS WITH STOCHASTIC

Institut de Recherce de l'Hydro-Quebec, Varennes.

A. Turgeon. Water Resources Research, Vol 16, No 2, p 275-283, April 1980. 5 Fig, 5 Tab, 20 Ref.

Descriptors: *Reservoir operation, *Optimization, *Hydroelectric power, *Model studies, Mathematical models, Stochastic processes, Powerplants, Peak power, Electric power demand, Reservoirs, Storage, Inflow, Rivers, Simulation analysis, Hydrology, Lakes, Multireservoir systems.

The optimization of the weekly operating policy of multireservoir hydroelectric power systems is a stochastic nonlinear programing problem. For small systems this problem can be solved by dynamic programing, but for large systems there is yet no method of solving this problem directly so that one must resort to mathematical manipulations in order to solve it. This napure presented and that one must resort to mathematical manipulations in order to solve it. This paper presented and compared two possible manipulation methods for solving this problem. The first, called the one-attaine method, consists in breaking up the original multivariable problem into a series of one-state variable subproblems that are solved by dynamic content of the first part of the first problems. variable subproblems that are solved by dynamic programing. The final result is an optimal local feedback operating policy for each reservoir. The second method, called the aggregation/decomposition method, consists in breaking up the original n-state variable stochastic optimization problem into a stochastic optimization subproblems of two-state variables that are also solved by dynamic programing. The final result is a suboptimal global feedback operating policy for the system of n reservoirs. The two methods were then applied to a network of six reservoir-hydroplant complexes, and the results obtained were reported. It was shown that the suboptimal global feedback operating policy gives better results than the optimal local feedback operating policy. (Sims-ISWS) W80-06146

ON THE STATISTICAL CHARACTERISTICS OF DROUGHT EVENTS,

California Univ., Los Angeles. School of Engineering and Applied Science.
For primary bibliographic entry see Field 2B.

ON THE DEFINITION OF DROUGHTS,

California Univ., Los Angeles. School of Engineering and Applied Science. For primary bibliographic entry see Field 2B. W80-06148

A FREQUENCY ANNUAL FLOODS. DISTRIBUTION FOR

Griffith Univ., Nathan (Australia). School of Australian Environmental Studies. W. C. Boughton.
Water Resources Research, Vol 16, No 2, p 347-354, April 1980. 8 Fig. 7 Tab, 6 Ref.

Descriptors: *Frequency analysis, *Floods, *Australia, *Distribution patterns, Frequency, Statistical methods, Annual flood, Statistics, Parametric hydrology, *Eastern Australia, Logarithms, Three-parameter distributions, Catchments, Frequency factor, Recurrence interval, Data sets, Gumbel distributions, and the sets, Gumbel distributions of the sets o

A distribution for frequency analysis of the logarithms of annual floods was derived from data for 78 catchments in eastern Australia. The statistical data from these catchments demonstrated the need for three-parameter distributions instead of twoparameter distributions for analysis of annual floods. A nonlinear relationship between frequency factor and function of recurrence interval was demonstrated, and this relationship was used as the basis for the distribution. Methods of fitting the distribution to data sets, including sets that contain zero values, were described. A comparison was made of results from the new distribution, the log Pearson type 3, the log normal, the log Gumbel, and the Gumbel distribution. (Roberts-ISWS) W80-06152

UNSTEADY ONE-DIMENSIONAL FLOW OVER A PLANE: PARTIAL EQUILIBRIUM AND RECESSION HYDROGRAPHS,

AND RECESSION HYDROGRAPHS, Institute of Hydrology, Wallingford (England). E. M. Morris, and D. A. Woolhiser. Water Resources Research, Vol 16, No 2, p 355-360, April 1980. 6 Fig. 4 Ref.

Descriptors: *Shallow water, *Overland flow, *Model studies, Mathematical models, Hydrographs, Unsteady flow, Surface waters, Runoff, Equations, Theoretical analysis.

This paper presented a comparison of solutions of the shallow water (Saint Venant) equations for unsteady one-dimensional flow over a plane and solutions of the diffusion and kinematic wave equasolutions of the unitation and attendance wave edua-tions, which were approximate forms of the Saint Venant equations. In the cases studied, the lateral inflow was constant and positive but may cease before a steady state flow is reached. It was shown before a steady state flow is reached. It was shown that for highly subcritical flow, the criterion proposed by Woolhiser and Liggett was necessary but not sufficient to enable a choice between the shallow water equations and the kinematic approximation. An additional criterion was proposed for these cases. (Sims-ISWS)
W80-06153

EFFECT OF TAIL BEHAVIOR ASSUMPTIONS ON FLOOD PREDICTIONS.

Clorado State Univ. Fort Collins. H. W. Shen, M. C. Bryson, and I. D. Ochoa. Water Resources Research, Vol 16, No 2, p 361-364, April 1980. 1 Fig. 3 Tab, 7 Ref.

Descriptors: *Flood forecasting, *Design flood, *Model studies, Mathematical models, Flood frequency, Hydrologic data, Frequency, Analytical techniques, Temporal distribution, Flow, Streamflow, Floods, Hydrology.

Two of the distributions most widely used in flood magnitude modeling are the Gumbel type 1 extreme-value distribution and the log Pearson type 3. These represent two fundamentally different assumptions about distribution tail behavior in that extreme events from the log Pearson type 3 distribution follow the Gumbel type 2 extremal distribution. This paper compared these two assumptions by comparing flood predictions by the type 1 and type 2 models. For the Gumbel type 1 distribution the ratio of x sub n sub 1, the magnitude of a flood with a return period n sub 1, to x sub n sub 2, the magnitude for a shorter return period n sub 2, can magnitude for a shorter return period n sub 2, can be estimated by an upper bound that is 1n n sub 1/ 1n n sub 2. It was shown that the ratio of x sub n sub 1/x sub n sub 2 from the type 2 distribution is

always greater than that from the type 1, approximated by (n sub 1/n sub 2) to the 1/k power. An analysis of flow data collected in the United States analysis of flow data collected in the Onled States indicated that in the majority of cases the best fitting type 2 distribution does not have a finite variance and often not even a finite mean. The impact of this on statistical data analysis was dis-cussed. (Sims-ISWS) W80-06154

FLOODING PROBLEMS IN A SMALL URBAN WATERSHED-DOAN BROOK, CLEVELAND,

Dalton-Dalton-Newport, Shaker Heights, OH. S. J. Nacht.

Water Resources Bulletin, Vol 16, No 3, p 401-407, June 1980, 5 Fig, 4 Tab, 17 Ref.

Descriptors: *Floods, *Urban runoff, *Urban hy-Descriptors: *Floods, *Urban lands, Control drology, *Ohio, Watersheds(Basins), Streamflow, Rainfall, Precipitation(Atmospheric), Drainage, Control. Hydrology, Hydraulics,

Analysis of a small urban watershed's flooding was undertaken to determine causes and solutions to this serious environmenal hazard affecting Univerthis serious environmental nazard artecting University Circle, the cultural heart of Greater Cleveland. Doan Brook is a small, highly distrubed urban stream draining 11.3 square miles. Much of the stream corridor and associated park land is owned by the public. The upper watershed lies in the communities of Shaker Heights and Cleveland communities of Shaker Heights and Cleveland Heights who lease parkland from Cleveland. Two 50-year floods seriously affected the Circle area in August 1 million in damages. These events resulted from excessive rainfall triggering rapid earth movement of valley walls in the upper watershed, decreased basin lag time from the infilling of several small upland lakes, a seriously undersized stream channel and storm culvert (at University Circle), and complex institutional excesspents between and complex institutional arrangements between the three communities in the watershed. Suggestions were presented for a methodology to resolve the technical aspects of the flooding problem. (Sims-ISWS) W80-06182

BIOMECHANICS OF VEGETATIVE CHANNEL LININGS,

Waterloo Univ. (Ontario). Dept. of Civil Engineer-

N. Kouwen, and R-M. Li.

Journal of the Hydraulics Division, American Society of Civil Engineers, Vol 106, No HY6, Proceedings Paper 15464, p 1085-1103, June 1996, Fig. 2 Tab, 31 Ref. 2 Append. EPA R805457-01.

Descriptors: *Open channel flow, *Vegetation effects, *Roughness(Hydraulic), Retardance, Hydraulics, Flow resistance, Flow, Vegetation, Friction, Mannings equation, Darcy-Weisbach equation, *Biomechanics, Vegetative channel linings.

A method to determine and apply the biomechanical properties of vegetative channel linings was presented. The method was used to evaluate the stiffness of vegetation commonly used to protect earth channels from erosion. Using the vegetation stiffness and stem length, the deflected height of the channel lining was predicted to yield a relative roughness under given flow conditions. The rela-tive roughness was used to calculate a value of the Darcy-Weisbach friction factor or Manning's n. A method to design a vegetated channel was includmethod to design a vegetated char ed. (Lee-ISWS) W80-06191

2F. Groundwater

A FIELD EXERCISE ON GROUND WATER FLOW USING SEEPAGE METERS AND MINI-PIEZOMETERS,

Waterloo Univ. (Ontario). Dept. of Earth Sciences. For primary bibliographic entry see Field 7B.

Group 2F—Groundwater

REGIONAL GROUND WATER FLOW NEAR A HIGH-LEVEL RADIOACTIVE WASTE RE-

POSITORY,
Dames and Moore, Los Angeles, CA.
A. K. Runchal, and T. Maini.
Dames and Moore Engineering Bulletin 50, p 1120, December, 1979. 10 Fig. 1 Tab, 14 Ref.

Descriptors: *Radioactive waste disposal, *Ground water movement, *Regional analysis, *Flow system, Flow rates, Aquifer characteristics, Bedrock, Crystalline rock, Convection, Radioisotopes.

Deep underground burial in stable geologic forma-tion may be the most economical, technically feasi-ble, and safest alternative for disposal of high-level radioactive waste. This paper examines the prob-lem of reliably defining the hydrogeologic proper-ties of a rock mass and predicting thermally induced regional ground water flow. An equivalent porous media approach was used to estimate transit time for radionuclides to reach the biosphere. For a generic granite repository, a thermal loading of 100 kw/acre alters the regional horizontal flow in to a convection cell pattern near the repository This reduces the transit time for radioactive nu clides to reach near-surface aquifers and the bio-sphere. The transit time may be as little as 40 years sphere. The trainst time may be as little as 40 years at the time of maximum influence (between 1000 and 4000 years after repository decommissioning). However, the total amount of flow through the repository is only on the order of one gallon per minute for the investigated range of hydrogeologic properties and repository scenarios. Parametric simulations indicate that this flow is largely controlled by thermal-loading. Changes in ground water flow rates caused by local variations in water flow rates caused by local variations in hydrogeologic properties, water table slopes, or boundary conditions are rather small. However, regional changes of hydrogeologic properties greatly influence flow patterns and flow rates. (Purdin-NWWA) W30-06018

EVALUATION OF INDUCED INFILTRATION BETWEEN THE RIVER SKERNE AND THE MAGNESIAN LIMESTONE IN SOUTH EAST

DURHAM, Plymouth Polytechnic (England). Dept. of Civil For primary bibliographic entry see Field 4B. W80-06020

SINGULARITIES IN D THROUGH POROUS MEDIA, DARCY

THROUGH POROUS MEDIA,
Cornell Univ., Ithaca, NY. School of Civil and
Environmental Engineering.
O. E. Lafe, J. S. Montes, A. H. O. Cheng, J. A.
Liggett, and P. L.-F. Liu.
Journal of the Hydraulics Division, Proceedings of
the American Society of Civil Engineers, Vol 106,
No HY6, p. 977-997, June, 1980. 19 Fig, 1 Tab, 9
Ref. 3 Append.

Descriptors: *Darcy's Law, *Potential flow, *Porous media, Ground water movement, Numerical analysis, Laplaces Equation, Singularities, Boundary processes, Cutoff walls, Interzonal flow, Permeability sinks, Water wells, Flow around ob-

Numerical analysis of potential flow often ignores Numerical analysis of potential flow often ignores singularities by assuming that the error will be localized in the vicinity of the singularity. Singularities occurring in problems of elasticity have been calculated by using superposition in which the regular and singular parts of the solution are separated with the singular part being represented analytically as finite series with undetermined coefficients. In this paper, the Boundary Interest Period. analytically as innite series with undetermined coef-ficients. In this paper, the Boundary Integral Equa-tion Method (BIEM) is used to solve for the regu-lar part with extra boundary nodes close to the singularity in order to provide enough equations for the determination of the unknown coefficients. The use of 'singular elements', where the interpo-lating function has same behavior as an analytical solution near a singularity, is explored. Singularities considered are: corner flow over a cutoff, interzonal flow between zones of different permeability; and the case of sources and/or sinks in the medium. The latter type of singularity is important

 $\mathsf{I}\mathsf{M}\mathsf{L}$

in ground water problems wit pumping wells. (Purdin-NWWA) W80-06021 with recharge and

FLUID FLOW IN NATURALLY FRACTURED RESERVOIRS,

Rice Univ., Houston, TX. Dept. of Geology. T. D. Streltsava-Adams

17. D. Streitsava-Adams. In: 2nd Invitational Well-Testing Symposium Proceedings, October 25-27, 1978, Berkeley, California, Lawrence Berkeley Laboratory, University of California, Berkeley, p 71-77. 4 Fig. 1 Tab, 27 Ref.

Descriptors: *Fracture permeability, *Flow, *Model studies, Aquifers, Drawdown, Aquifer tests, Compaction, Porosity, Fractures(Geologic).

Analyses of naturally fractured reservoir rocks show that overall permeability is increased due to high fracture permeability. The diversity in fracture pattern and fracture-matrix properties is seen in reservoir performance which displays a variety of responses to an induced pressure change. These include the s-shaped transient pressure type, the homogeneous reservoir type, the two-asymptotic lines type, the reverse distance-drawdown type, etc. A double porosity fluid flow model is presented in which the medium is assumed to consist of randomly distributed fractures breaking up the matrix into porous blocks of irregular size and shape. A general approach for developing a fluid flow model is considered first. The pressure drawdown is then presented for fractures and matrix. down is then presented for fractures and matrix. Reservoir behavior may be uniquely interpreted only if the reservoir properties are known independently. Changes in rock properties during production is of particular importance in analyzing reservoir performance. A combined drawdown and voir performance. A combined drawdown and buildup test may give an insight into the compaction response of a formation. Multi-well pressure interference tests and core data may also help eliminate uncertainties in interpreting the diversive behavior of fractured formations. (Purdin-NWWA) W80-06024

DEPTH CONSTRAINTS ON THERMAL STOR-AGE WELLS,

Houston Univ., TX.
For primary bibliographic entry see Field 8B. W80-06025

EFFECTS OF KARST AND GEOLOGIC STRUC-TURE ON THE CIRCULATION OF WATER PERMEABILITY CARBONATE AQUIFERS,

Geological Survey, Reston, VA. V. T. Springfield, J. R. Rapp, and R. B. Anders. Journal of Hydrology, Vol 43, No 1/4, p 313-332, October, 1979. 3 Fig, 66 Ref.

Descriptors: *Karst hydrology, *Structural geology, *Ground water movement, *Permeability, *Carbonate rocks, Karst, Sinks, Water circulation, Flow systems, Fractures(Geologic), Solubility, Joints(Geologic), **Entitle Cartific South Structure (Geologic), Subject Cartific South Structure (Geologic), **Entitle Cartific South Structure (Geologic), Subject Cartific South Structure (Geologic), **Entitle Faults(Geologic), Aquifers, Specific yield.

Karstification results from the dissolution and leaching of carbonates, evaporities and other solu-ble rocks. Karst features are classified as: (1) surfi-cial features that do not extend far below the surface; and (2) features such as sinkholes that extend below the surface and affect water circulaextend below the surface and affect water circula-tion. The permeability of highly productive car-bonate aquifers is due chiefly to enlargement of fractures and other openings by water circulation. Depth of circulation depends on the difference in elevation between recharge and discharge areas. Important factors in the development of karst and Important factors in the development of karst and permeability in carbonate aquifers include: climate; topography; solubility of the rocks; geologic structure; ground water circulation; base level; and the surface conditions under which the rocks are first exposed to meteoric water. In compact carbonate rocks, joints, fractures, and bedding planes are essential for the development of a circulation system. Where rocks are not horizontal, water may move parallel to the dip. On breached anticlines, water may move parallel to the strike. Faults may

restrict the lateral movement of water or serve as channels for deep circulation. Three types of karst aquifers are described based on yield. The aquifers with the largest yields include five of the most productive in the U.S.A. (Purdin-NWWA) W80-06027

MAJOR GEOCHEMICAL PROCESSES IN THE EVOLUTION OF CARBONATE-AQUIFER SYS-TEMS.

IEMAS, Geological Survey, Reston, VA. B. B. Hanshaw, and W. Back. Journal of Hydrology, Vol 43, No 1/4, p 287-312, October, 1979. 10 Fig. 13 Ref.

Triology.

This paper examines geochemical processes in carbonate aquifer formation and transformation. Permeability and porosity of carbonate aquifers vary greatly due to mode and environment of deposition and high reactivity of carbonate minerals. Ground water chemistry is controlled by recrystallization, dolomitization, cementation, structural activity, dissolution and reprecipitation of minerals during ground water movement, and mass transfer of chemical species. Aragonite, calcite and dolomite have a major influence on ground water chemistry. Most carbonate aquifers composed of sand-size materials have high initial porosity. Carbonate rocks deposited as fine-grained muds have extremely low permeability that requires fracturing and dissolution to develop into aquifers. Most sand beds and reefs are good aquifers. Porosity and permeability can be changed by selective dissolution, inversion of aragonite to calcite, recrystallization, inversion of aragonite to calcite, recrystalliza-tion, and dolomitization. Predictive models devel-oped by mass-transfer and chemical equilibrium calculations demonstrate the controlling reactions oped by mass-transfer and chemical equilibrium calculations demonstrate the controlling reactions in aquifer systems. To fully understand the functioning of a carbonate aquifer system requires knowledge of: head distribution, porosity, permeability and chemistry of ground water; boundary conditions; tectonic history; and the sedimentologic and mineralogic framework. As predictive chemical models become more widespread, the expertise of asphanter setrologists and geochemists. expertise of carbonate petrologists and geochemists will become increasingly integrated in the hydrologists' studies of ground water systems. (Purdin-NWWA) W80-06031

GROUND WATER SIMULATION USING A ONE DIMENSIONAL FLOW MODEL, Youngstown State Univ., OH. Dept. of Civil Engineering.
For primary bibliographic entry see Field 7C.
W80-06044

MAPS SHOWING GROUND-WATER CONDI-TIONS IN THE HOPI AREA, COCONINO AND NAVAJO COUNTIES, ARIZONA--1977, Geological Survey, Tucson, AZ. Water Resources For primary bibliographic entry see Field 7C. W80-06052

GENERALIZED CONFIGURATION OF THE BOTTOM OF THE FLORIDAN AQUIFER, SOUTHWEST FLORIDA WATER MANAGE-MENT DISTRICT,
Geological Survey, Tallahasses, FL. Water Re-

For primary bibliographic entry see Field 7C. W80-06054

GENERALIZED THICKNESS OF THE CON-FINING BED OVERLYING THE FLORIDAN AQUIFER, SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT, Geological Survey, Laguna Niguel, CA. Water Resources Div.

For primary bibliographic entry see Field 7C.

W80-06055

CLASSIFICATION OF GROUND-WATER RE-CHARGE POTENTIAL IN THREE PARTS OF SANTA CRUZ COUNTY, CALIFORNIA, Geological Survey, Menlo Park, CA. Water Resources Div. For primary bibliographic entry see Field 4B. W80-06056

WATER QUALITY OF FLORIDA SPRINGS, Geological Survey, Tallahassee, FL. Water Resources Div For primary bibliographic entry see Field 1A. W80-06058

GEOHYDROLOGIC DATA FOR THE LOWER WOOD RIVER GROUND-WATER RESERVOIR, RHODE ISLAND,
Geological Survey, Providence, RI. Water Re-For primary bibliographic entry see Field 7C. W80-06068

FLOW NET FOR UNSATURATED INFILTRA-TION FROM PERIODIC STRIP SOURCES, Karadeniz Teknik Univ., Trabzon (Turkey). Dept. of Civil Engineering and Architecture. For primary bibliographic entry see Field 2G. W80-06089

SEEPAGE VS. TERRACE DENSITY IN RE-CLAIMED MINELAND SOIL, North Dakota State Univ., Fargo. Dept. of Agron-For primary bibliographic entry see Field 2G. W80-06107

A STATISTICAL APPROACH TO THE INVERSE PROBLEM OF AQUIFER HYDROLOGY, 3. IMPROVED SOLUTION METHOD AND ADDED PERSPECTIVE, Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.

Water Resources S. P. Neuman. Water Resources Research, Vol 16, No 2, p 331-346, April 1980. 6 Fig, 2 Tab, 18 Ref, 5 Append.

Descriptors: *Groundwater, *Aquifers, *Model studies, Mathematical models, Statistica, Statistical models, Transmissivity, Groundwater movement, Water levels, Finite element analysis, Theoretical analysis, Hydrology, Inverse problem.

Paper 1 of this sequence presented a new statisti-cally based approach to the problem of estimating spatially varying aquifer transmissivities on the basis of steady water level and flux data. Paper 2 spatiany varying adulter transmissivities on the basis of steady water level and flux data. Paper 2 described a case study in which the new method had been applied to actual field data from the Cortaro Basin in southern Arizona. The purpose of paper 3 was to introduce a new efficient method of solution that works under a much wider range of conditions than the method employed in papers 1 and 2. The new method was based on a variational theory developed by Chavent, which was extended to the case of generalized nonlinear least squares. The method was implemented numerically by a finite element scheme. The inverse problem was posed in terms of log transmissivities instead of transmissivities and was solved by a Fletcher-Reeves conjugate gradient algorithm in conjunction with Newton's method for determining the step size to be taken at each iteration. The method step size to be taken at each iteration. The method does not require computing sensitivity coefficients, does not require computing sensitivity coefficients, and one may therefore expect it to result in considerable savings of both computer storage and computer time. Posing the problem in terms of log transmissivities was shown to have important advantages over the traditional approach, not the least of which is guaranteeing that the computed transmissivities will always be positive. The paper included a theoretical analysis of the effect that various errors corrupting the data and the model may have on the final log transmissivity estimates. (Sims-ISWS) (Sims-ISWS)

A NOTE ON THE MEANING OF STORAGE COEFFICIENT,
California Univ., Berkeley. Lawrence Berkeley

Lab. T. N. Narasimhan, and B. Y. Kanehiro. Water Resources Research, Vol 16, No 2, p 423-429, April 1980. 1 Tab, 14 Ref. DOE W-7405-ENG-48.

Descriptors: *Groundwater, *Storage coefficient, *Model studies, *Mathematical models, Aquifers, Storage, Unsteady flow, Porous media, Porosity, Pore pressure, Theoretical analysis, Equations, Theis equation, Hydrology.

The term storage coefficient and the related expressions, storativity, specific storage, and total compressibility, are frequently used in hydrogeology, petroleum engineering, and other fields. These parameters seek to express the quantity of water required to be added to or removed from storage in order to change (under conditions of drainage) the average hydraulic head or pore pressure of a portous material by a given amount. Originally introduced over 4 decades ago, the storage parameter is still used by many in the restricted sense of a coefficient occurring in the partial difference of the coefficient occurring in the partial difference occurring in the parti age parameter is still used by many in the restricted sense of a coefficient occurring in the partial differential equation describing fully saturated flow. However, with the significant increase in our computational abilities using powerful numerical integration techniques, there presently exists a need to have a more fundamental appreciation of the storage parameter as it relates to transient fluid flow in porous media. Such a fundamental approach requires consideration of the type of loading to which the porous medium is subject as well as certain conventions followed by various workers in actually defining the parameter. While no new derivations or results were presented, this paper attempted to assemble in a single place the various ideas relevant to the storage parameter in order to obtain a generalized perspective. (Sims-ISWS)

THE TRANSPORT OF A RADIOACTIVE SALT THROUGH A SEMI-INFINITE COLUMN OF POROUS MEDIUM: A PHYSICAL MODEL, California Univ. Livermore. Lawrence Livermore For primary bibliographic entry see Field 5B. W80-06141

THE EFFECT OF SOIL ACTIVITY ON THE CHEMISTRY OF CARBONATE GROUND-McMaster Univ., Hamilton (Ontario). Dept. of Geography. For primary bibliographic entry see Field 2K. W80-06142

ON JACOB'S APPROXIMATION IN FLOW THROUGH POROUS MEDIA, Punjab Agricultural Univ., Ludhiana (India). Dept. of Soil and Water Engineering. S. R. Singh, and B. Sagar. Water Resources Research, Vol 16, No 2, p 377-380, April 1980. 1 Fig, 10 Ref.

Descriptors: *Groundwater, *Porous media, *Drawdown, *Mathematical models, Model studies, Approximation method, Analytical techniques, Equations, Flow, Groundwater movement, Fluid mechanics, Aquifers, Wells, Water wells, Oil wells, Hydraulics, Well hydraulics.

The equation of flow of slightly compressible The equation of flow of slightly compressible fluids through nondeformable, or consolidating, porous media is a nonlinear parabolic partial differential equation has been approximately linearized by neglecting its nonlinear term. This method of linearization, hereafter called Jacob's method, was first introduced by C.E. Jacob for flow of groundwater in confinct parties of the produced by C.E. Jacob for flow of groundwater in confinct parties. introduced by C.E. Jacob for flow of groundwater in confined aquifers. In this article the method of functional transformation was used to find a transformation that exactly linearized the equation. A problem of constant drawdown well in extensive homogeneous and isotropic consolidating, or non-deformable, porous media was solved. Solution of the approximately linearized differential equation

for the aforesaid problem was compared with the exact one, and the error due to the neglect of the nonlinear term was analyzed. It was shown that the error resulting from Jacob's approximate method of linearization for flow of water through confined aquifers is negligible. However, in the case of the transport of other compressible fluids through nondeformable formations the error is not insignificant. (Sims-ISWS)

MASS TRANSPORT: 1. A STOCHASTIC ANALYSIS OF MACROSCOPIC DISPERSION, Utah Univ., Salt Lake City. Dept. of Geology and Geophysics.
L. Smith, and F. W. Schwartz.
Water Resources Research, Vol 16, No 2, p 303-313, April 1980. 10 Fig, 2 Tab, 17 Ref.

Descriptors: *Dispersion, *Mass transfer, *Groundwater, *Porous media, *Model studies, Mathematical models, Groundwater movement, Diffusion, Hydraulic conductivity, Porosity, Tracers, Stochastic processes, Analytical techniques, Macroscopic dispersion.

Conventional modeling of mass transport in groundwater systems usually involves use of the dispersion-convection equation with large values of porous medium dispersivity to account for macroscopic dispersion. This work described a modeling concept that accounts for macroscopic dispersion. ing concept that accounts for macroscopic dispersion not as a large-scale diffusion process but as mixing caused by spatial heterogeneities in hydraulic conductivity. The two-dimensional spatially autocorrelated hydraulic conductivity field was generated as a first-order nearest-neighbor stochastic process. Analysis of a variety of hypothetical media showed that over finite domains a population of tracer particles convected through this statistically homogeneous conductivity field does not have the normal distribution and does not yield the constant dispersivity that classic theory would predict. This problem occurs because of insufficient spatial averaging in the macroscopic velocity field by the moving tracer particles. Our analyses suggested that the diffusion model for macroscopic dispersion may be inadequate to describe mass transport in geologic units. Sensitivity analysis with the model has shown that features of transport, such as first arrival of a tracer, are dependent port, such as first arrival of a tracer, are dependent on porous medium structure and that even when the statistical features of porous media are known, considerable uncertainty in the model result can be expected. (Sims-ISWS) W80-06149

THERMOHALINE INSTABILITY IN ANISO-TROPIC POROUS MEDIA,
Oslo Univ. (Norway). Dept. of Mathematics. Water Resources Research, Vol 16, No 2, p 325-330, April 1980. 3 Fig. 12 Ref, 1 Append.

Descriptors: *Groundwater, *Porous media, *Salts, *Temperature, *Model studies, Mathematical models, Convection, Groundwater movement, Chemical precipitation, Anisotropy, Stability, Water pollution, Pollutants, Thermohaline, Salt

The onset of thermohaline convection in a horizontal porous layer was investigated theoretically. The layer was homogeneous, anisotropic, and of infinite horizontal extent. Horizontal isotropy with infinite norizontal extent. Horizontal isotropy with respect to permeability, thermal diffusivity, and solute diffusivity was assumed. For porous media with thermally insulating solid matrices the stability diagram has the same shape as in the case of isotropy. The critical wave number is constant and equal to that of the one-component case. For therefore, the contract of the con mally conducting matrices, new features may occur; the locus of the direct mode in the stability diagram may not be a straight line, and the corre diagram may not be a straight line, and the corre-sponding wave number may be nonconstant. The initiation of salt fingers was studied by linear theory. It seems that the width of salt fingers is influenced by anisotropy in the diffusivities. Aniso-tropy may or may not favor salt fingers, depending on a dimensionless diffusion parameter D being greater than or less than 1. (Sims-ISWS)

Field 2-WATER CYCLE

Group 2F—Groundwater

W80-06151

STORAGE OF FRESHWATER IN SALINE AOUIFERS Haryana Agricultural Univ., Hissar (India). Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 4B.
W80-06199

2G. Water In Soils

DYNAMIC SYSTEM FOR MEASURING SOIL-MOISTURE CHARACTERISTICS AT VARIOUS TEMPERATURES.

Wisconsin Univ.-Madison.
J. R. Nimmo, E. E. Miller, and W. R. Gardner. J. K. Nimmo, E. E. Miller, and W. R. Gardner. Available from the National Technical Information Service, Springfield, VA 2161 as PB80-204670, Price Codes: A03 in paper copy, A01 in microfiche. Water Resources Center, University of Wisconsin, Madison, Technical Report WIS WRC 80-11, 1980. 33 p, 16 Fig. 1 Tab, 9 REf. OWRT A-072-WIS(1),134-00071-05;1434-0001-7106;14-34-001. 0001-8053

Descriptors: *Richards apparatus, *Soil moisture, *Moisture content, Soil temperature, *Temperature, *Tensiometers, *Water measurement, Soil

Many methods have been devised for measuring soil moisture characteristics, but few have yield complete characteristics—i.e., sets of values for all three properties for wetting, drying, and intermediate-reveral (scanning-curve) conditions. The isotemal moisture charactristics of soils are considerated to the considerate of the consid ably more difficult to measure for 'real' soils than for glass-bead media. The objective of this work was to utilize modern technical developments for performing these measurements. In addition, the measurements of characteristics were repeated at several temperatures. A system developed at the University of Wisconsin-Madison for performing these measurements is described. W80-06077

APPLICATION OF RECENT RESULTS IN FUNCTIONAL ANALYSIS TO THE PROBLEM OF WETTING FRONTS,

Cold Regions Research and Engineering Labora tory, Hanover, NH. Y. Nakano.

Water Resources Research, Vol 16, No 2, p 314-318, April 1980. 16 Ref, 1 Append.

Descriptors: *Wetting, *Porous mdia, *Mathematical models, Equations, Darcys law, Infiltration, Theoretical analysis, Mathematical studies, *Functional analysis, *Wetting fronts, *Singular surfaces.

Traditionally in hydrology and soil physics, wet-ting fronts appearing in porous media described by Darcy's law have not generally been considered to be singular surfaces. Some recent results from functional analysis were presented as evidence sup-porting the viwpoint that wetting fronts with a finite propagating speed generally are singular sur-faces. (Visocky-ISWS)

FLOW NET FOR UNSATURATED INFILTRA-TION FROM PERIODIC STRIP SOURCES, Karadeniz Teknik Univ., Trabzon (Turkey). Dept. of Civil Engineering and Architecture. V. Batu.

Water Resources Research, Vol 16, No 2, p 284-288, April 1980. 5 Fig, 15 Ref.

Descriptors: *Flow nets, *Infiltration, *Unsaturated flow, *Mathematical models, Water table aquifers, Groundwater movement, Equations, Irrigation, Model studies, Steady flow, Depth, Stream functions.

 $\mathsf{I}\,\mathsf{M}\,\mathsf{L}$

Using unsaturated flow theory, authors have obtained general equations of the stream functions for a variable infiltration rate over periodic strip sources located on the soil surface. In this paper

solutions were obtained for the water table located at infinite and finite depths. The steady state unat infinite and finite depths. The steady state unsaturated flow equation, linearized using the Kirchhoff transformation based on the exponential relationship between the unsaturated hydraulic conductivity and soil water pressure, was solved with the Fourier analysis technique. The solutions for equally spaced strip sources were obtained with the constant infiltration rate as a special case. As another special case, an approximate result for infinite water table depth was obtained for an array of equally spaced line sources which was first obtained by Raats (1970). Using the matric flux potential distribution for the infinite water table depth (Batu, 1978), the author presented flow nets for equally spaced strip sources. The stream functions corresponding to the saturated flow cases for equally spaced strip sources. The stream functions corresponding to the saturated flow cases were also obtained. Comparisons between the saturated and unsaturated streamlines were made, and it was concluded that the discrepancies between the two are larger with decreasing matric flux potential in the flow field. These solutions are of interest in connection with sprinkler and furrow irrigation. Other than these uses, the results may be used for different purposes in civil and agricultural engineering applications. (See also W71-00558, W79-00471) (Visocky-ISWS) W80-06089

SEEPAGE VS. TERRACE DENSITY IN RE-CLAIMED MINELAND SOIL, North Dakota State Univ., Fargo. Dept. of Agron-

Omy, L. Prunty, and D. Kirkham. Journal of Environmental Quality, Vol 9, No 2, p 273-278, April-June 1980. 5 Fig, 1 Tab, 10 Ref. SEA-EPA 684-15-2.

Descriptors: *Seepage, *Infiltration, *Saturated flow, *Mathematical models, Model studies, Pollutants, Path of pollutants, Leacing, Mine wastes, Terracing, Groundwater movement, Soil water movement, Flow, Potential flow, Topography, Re-

The seepage pattern of infiltrated water through hillside mine overburden materials is of concern hillside mine overburden materials is of concern because of the possible pollution hazard presented by leachates. In this paper detailed seepage patterns as found by Gram-Schmidt analysis were presented for: (1) a uniform-slope topography, (2) a four-terrace topography, and (3) a one-terrace topography. The aspect ratio (depth/width of the mine pit) of 1:40 and average slope of 5% were the same for each topography and correspond approximately to the aspect ratio and slope of an actual research coal mine. The volume of overburden was also the same for each topography. Saturation of the overburden was assumed. The results, therefore, depicted the maximum possible seepage condition for each topography, not average or normaldition for each topography, not average or normally expected conditions. A plot of the total relative seepage rate as a function of the reciprocal of the seepage rate as a function or the reciprocal of the terrace density (number of terraces) was presented. The total seepage rate for the four-terrace topogra-phy was 10 times greater than for the uniform-slope topography. (Sims-ISWS) W80-06107

FIELD HETEROGENEITY: SOME BASIC

Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Environmental Mechanics. J. R. Philip.

J. R. Philip. Water Resources Research, Vol 16, No 2, p 443-448, April 1980. 4 Fig, 37 Ref.

Descriptors: *On-site investigations, *Theoretical analysis, *Soil water movement, *Model studies, *Heterogeneity, Soil physics, Stochastic processes, Absorption, Infiltration, Soils, Mathematical studies, Unsaturated flow, Soil texture, Deterministic heterogeneity, Stochastic heterogeneity.

Present-day soil-water physics enables useful quantitative predictions in the laboratory and in simple field situations. Difficulties, however, frequently arise for areas of appreciable size in the field. Known and unknown heterogeneities, on many scales, may vitiate predictions based on theory for

homogeneous, or very simple heterogeneous, systems. Some aspects of unsaturated and generally unsteady flow in heterogeneous systems were reviewed: the mathematical nature of the flow equation, the concept of scale-heterogeneity, analytical and quasi-analytical solutions. The enormity of the total problem of unsaturated unsteady flows in and quasi-analytical solutions. The enormity of the total problem of unsaturated unsteady flows in stochastic heterogeneous systems was illustrated through a dialectic of eight successive stages of simplification. The concept of the autocorrelation function governing lambda, the internal characteristic length, was introduced; and the problem was posed in terms involving the distribution and autocorrelation functions of lambda, the reduced potential and conductivity functions, and the initial and boundary conditions as the data, from which it is required to establish distribution functions of various descriptors of the flow. The solution to a grossly simplified example of horizontal absorption was presented. Mean apparent sorptivity decreases rapidly to about one-fifth of the mean (and about half the minimum) sorptivity of the component soils. Variation about the mean is very great but decreases as absorption proceeds. (Visocky-ISWS) W80-06137

THE TRANSPORT OF A RADIOACTIVE SALT THROUGH A SEMI-INFINITE COLUMN OF POROUS MEDIUM: A PHYSICAL MODEL, California Univ. Livermore. Lawrence Livermore

For primary bibliographic entry see Field 5B. W80-06141

NUMERICAL ANALYSIS OF INFILTRATION INTO A SAND PROFILE BOUNDED BY A CAPILLARY FRINCE, New South Wales Univ., Kensington (Australia); and Royal Military Coll., Duntroon (New Zealard)

A. A. Curtis, and K. K. Watson.
Water Resources Research, Vol 16, No 2, p 365-371, April 1980. 12 Fig, 14 Ref.

Descriptors: *Infiltration, *Capillary fringe, *Numerical analysis, *Model studies, Mathematical models, Drainage, Tile drainage, Air, Soils, Airwater interfaces, Pressure, Soil water, Soil water movement, Irrigation, Moisture content, Sand profiler

The rapid response sometimes observed in a tile drain system following surface ponding of water was discussed in terms of the air compressibility effect. An earlier numerical study describing water movement into a bounded profile with a lower boundary impermeable to the passage of both air and water was reviewed with particular reference to the validity of the time-dependent boundary condition transformation used in simulating the inhibiting effects of the air pressure increase on infiltration. The extension of the transformation approach to a profile bounded by a capillary fringe was then considered in detail, and the results of numerical analyses were presented for infiltration numerical analyses were presented for infiltration into two columns of a fine sand initially in hydraulic equilibrium from a prior gravity drainage regime. The shorter column developed a steady state flow condition at short times which was consistent with earlier experimental findings. In contrast, the pressure of the entrapped air in the longer column gradually increased as infiltration proceeded until the analysis was terminated when air excape through the lower boundary was imminent. (Sims-ISWS) state flow condition at short times which was

AN AUTOMATED SYSTEM FOR MEASURING SOIL WATER POTENTIAL GRADIENTS IN A RHIZOTRON SOIL PROFILE, Science and Education Administration, Auburn,

F. L. Long, and M. G. Huck. Soil Science, Vol 129, No 5, p 305-310, May 1980. 2 Fig, 24 Ref.

Descriptors: oil moisture, Moisture content, Root zone, Rhizosphere, Soil profiles, Soils, Agriculture.

A family of soil water potential curves, nearly continuous with time, is necessary to calculate soil

Lakes-Group 2H

water movement in the soil profile. Frequent personal reading to obtain such curves is both time consuming and costly. A system was described that automatically measures soil water potential in a soil-root environment in rhizotron studies. The system will be automatically conserved fluid surface. system utilizes automatically operated fluid switch wafers that are capable of switching as many as 24 tensionmeters to a single pressure transducer for measurement. The tranducer is sufficiently sensi-tive to measure differences as small as 0.003 bar easily. With frequent automatic readings and ten-siometers placed at various soil depths, the data are someters placet a various son technis, net that are recorded on magnetic tape by a data-acquisition system from which they go to a plotter where a essentially continuous water potential curve of a soil profile is obtained. (Sims-ISWS) W80-06188

THE EFFECT OF MOISTURE ON PHOSPHO-RUS DIFFUSION IN COAL MINE SPOILS, North Dakota Univ., Grand Forks, Dept. of Phys-

For primary bibliographic entry see Field 5C. W80-06186

ANALYTICAL-NUMERICAL COMPUTATION OF INFILTRATION, Florida Univ., Gainesville. Dept. of Civil Engi-

neering.
A. D. Koussis, and S-L. Chow.
Journal of the Irrigation and Drainage Division,
American Society of Civil Engineers, Vol 106, No
IR2, Proceedings Paper 15494, p 123-134, June
1980. 2 Fig, 15 Ref, 2 Append.

Descriptors: *Infiltration, *Porous media, *Model studies, Mathematical models, Analytical techniques, Irrigation, Soils, Soil water, Soil water movement, Unsaturated flow, Gravity, Moisture content, Diffusion, Sorption, Hydrology.

An approximate, analytical-numerical solution was developed for one-dimensional, vertical infiltration of water into soil. The soil diffusivity was assumed to vary either exponentially or as a power law; however, other analytical formulations can also be accommodated. The solution was physically based, involving parameters related to the soil properties, and is valid for 'short times' of infiltration. Its center piece was a simple, rapid, and sufficiently accurate solution for the sorption process. This accurate solution for the sorption process. Inis solution was of the similarity type, and the mois-ture gradient was given in analytical form. The remaining integration of the initial value problem was performed numerically to obtain the moisture distribution. Comparisons with exact numerical solutions were used to test the accuracy of the solu-tion. The influence of gravity was accounted for approximately, following Philip's theory, by an additive series term that was determined numeriadditive series term that was determined numeri-cally from the integration of a linear ordinary differential equation. Sorptivity was expressed completely analytically thus providing a simple, and physically rational, algebraic relationship for the cumulative infiltrated volume and the infiltration rate. (Sims-ISWS) W80-06196

DRAIN DEPTH AND SUBIRRIGATION IN

North Carolina State Univ. at Raleigh. Dept. of Biological and Agricultural Engineering. For primary bibliographic entry see Field 3F. W80-06197

WATER RETENTION MEASUREMENT FOR

SOILS, Feng Chia Coll. of Engineering and Business, Taichung (Taiwan). Dept. of Hydrology Engineering. C. Su, and R. H. Brooks. Journal of the Irrigation and Drainage Division, American Society of Civil Engineers, Vol 106, No IR2, Proceedings Paper 15483, p 105-112, June 1980. 3 Fig. 7 Ref, 1 Append.

Descriptors: *Soil water, *Retention, *Drainage, *Laboratory tests, Instrumentation, Measurement, Equipment, Water storage, Groundwater, Wetting, Drying, Pressure, Soil pressure, Fore pressure, Soil

science, Agricultural engineering, Water retention

A method for rapidly obtaining water retention data for soils was presented. A variation of the Richard's pressure cell was used in which equilibri-um at a particular water content was achieved by um at a particular water content was achieved by adjustment of the outflow pressure, rather than by permitting equilibrium to be reached at a fixed increment of water pressure. On the wetting cycle, water was added directly to the sample rather than being imbibed through the capillary barrier. The result was that data on both wetting and drying cycles can be obtained in a small fraction of the time needed for conventional procedures. Consist-ent data that fit on a smooth curve have been obtained. The results were thought to be comparaobtained. The results were thought to be comparable to those determined by the Richard's procedure except, possibly, in a range of water contents greater than that at which an interconnected air phase exists. (Sims-ISWS)

PROFILE SOIL MOISTURE FROM SURFACE MEASUREMENTS,

Science and Education Administration, Beltsville, MD. Hydrology Lab.

MD. Hydrology Lab. T. J. Jackson. Journal of the Irrigation and Drainage Division, American Society of Civil Engineers, Vol 106, No IR2, Proceedings Paper 15474, p 81-92, June 1980. 5 Fig. 1 Tab, 6 Ref, 1 Append.

*Soil moisture. Descriptors:

*Remote_sen *Remote sensing, *Model studies, Mathematical models, Simulation analysis, Soil moisture meters, Soil physical properties, Soil physics, Soil properties, Moisture content, Soil water, Hydraulic conductivity, Infiltration, Soil science.

A method was presented for predicting the volu-metric soil moisture of the soil profile from the surface layer soil moisture measurement and information on the soil properties of the profile under bare soil conditions. This method was based upon oare soil conductors. In a mentod was cased upon soil physics relationships and the assumption of hydraulic potential equilibrium throughout the profile. This procedure was tested using data gen-erated with a soil-moisture simulation model for a variety of situations involving bare soils. Results indicated that this procedure can be used to predict profile soil moisture within acceptable error bounds under some conditions. However, the sur-face layer measurements should be made during predawn period. The optimal surface layer thickness inferred from the analyses was about 0.1 m (4 in.). These results provide some guidelines for developing remote sensing methods for soil-moisture determination. (Sims-ISWS) W80-06200

2H. Lakes

OPTIMUM SPILLWAY BREADTH FOR GRAV-

TITY DAMS,
University of Strathclyde, Glasgow (Scotland).
Dept. of Civil Engineering.
J. M. Townson.

J. M. 10Wnson. Journal of the Hydraulics Division, American So-ciety of Civil Engineers, Vol 106, No HY3, Pro-ceedings Paper 15254, p 409-422, March 1980. 10 Fig. 1 Tab, 7 Ref, 2 Append.

Descriptors: *Dams, *Spillways, *Flood control, *Storage, Dam design, Gravity dams, Costs, Economics, Routing, Numerical analysis, Overflow, Reservoirs, *Spillway breadth, Gradient search technique. Overflow spillways.

The provision of overflow capacity in an impounding reservoir may occupy a large fraction of the total project cost. With a higher cost per unit volume than elsewhere in the dam, an optimum spillway flow breadth exists that minimizes total cost. This optimum was explored for simple gravity dams both under the restriction of negligible storage and with finite storage using level pool routing combined with a gradient search technique. It was found to be a sensitive product of cost ratio, peak inflow, and duration. A dimension-

less treatment of the quantities involved made possible the comparison of four widely different dams, three constructed in the United States and one in the United Kingdom. All were found to have spillway breadths close to the optimum. Since small variations from the optimum may result in cost increases that are large in absolute terms, the concept appears useful as a datum for economic assessments at feasibility stage. (Singh-ISWS) W80-06097

WINDPOWER TIME SERIS ABOVE A TEM-

WINDPOWER TIME SERIS ABOVE A TEM-PERATE LAKE, Wisconsin Univ.-Madison. Water Chemistry Lab. R. E. Stauffer. Limnology and Oceanography, Vol 25, No 3, p513-528, May 1980. 10 Fig. 5 Tab, 52 Ref.

Descriptors: +Lakes, *Winds, +Wisconsin, *Model studies, *Limnology, Time series analysis, Analytical techniques, Analysis, Temperate, Onsite data collections, Data collections, Mathematical models, Histograms, Profiles, Wind velocity, Drag, Flow characteristis, Computer models, Energy, *Lake Mendota(WI), Windpower.

A computer model of windpower flux was developed for lake Mendota, Madison, Wisconsin, Based on 3-h wind speeds and estimates of above-lake bulk Richardson number. The model then was bulk Richardson number. The model then was applied to the period 1 April-31 october (1966-1975). Fifteen years (1962-1976) of hourly records were also analyzed for Simcoe, Ontario (Lake Erie Basin). Expected power varies diurnally during all seasons, in phase with, or lagging slightly behind the solar cycle. The diel amplitude is about 46% of the expected daily mean. At both Simcoe and Madison, the expected daily power above an ice-free lake attains a broad maximum of 1,200,000-1,400,000 ergs/sq cm/d in winter and early spring, drops sharply in late April, and shows a broad summer minimum of 300,000-400,000 ergs/sq cm/d insolation show evidences of periodicity of about 7 days, probably related to synopti-scale cold front insolation show evidences of periodicity of about / days, probably related to synopti-scale cold front passages. Following the front, with its characteris-tic wind directional shift from SSW to NNW, a characteristic calm develops accompanied by in-tense solar radiation. The spring power histogram features a mdian value about half of the mean, because of the high probability of observing very because of the high probability of observing very low windpower coupld with a very long tail on the frequency distribution. Low power also shows a strong clustering tendency in spring because of both the strong inversion conditions in that season and the period of about 7 days in the synoptic-scale weather shifts. (Humphreys-ISWS) W80-06112

CHARACTERIZATION OF ORGANIC NITRO-GEN IN NATURAL WATERS: ITS MOLECU-LAR SIZE, PROTEIN CONTENT, AND INTER-ACTIONS WITH HEAVY METALS, Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences. J. R. Tuschall, Jr., and P. L. Brezonik.

Limnology and Oceanography, Vol 25, No 3, p 495-504, May 1980. 4 Fig. 4 Tab, 32 Ref.

*Organic compounds, Jessi-pioris: "Organic compounds, "Nitrogen, o'Lakes, "Florida, Freshwater, Water quality, Heavy metals, Organic matter, Amino acids, Algae, Proteins, Laboratory tests, Methodology, Analysis, Sampling, Analytical techniques, Data collections, Copper, "Lake Apopka(FL), "Lake Weir(FL), "Lake Weir(FL)

The nitrogenous organic matter from two freshwater lakes and from the filtrate of a unialgal water takes and from the intrate of a unuagai culture of Anabaena sp. was characterized chemi-cally and evaluated for metal complexation ability. Proteinaceous matter was isolated from acidified samples by cellulose cation exchange columns and eluted with a basic salt solution. Isolated proteineluted with a basic salt solution. Isolated proteina-ceous matter accounted for 14-34% of the original dissolved organic nitrogen. Gel permeation chro-matography and ultrafiltration methods used to separate dissolved organic nitrogen into various size fractions yielded differing results, but most of the organic nitrogen had apparent molecular weights between 10,000 and 50,000 daltons. The copper-complexing capacity of the proteinaceous

Field 2-WATER CYCLE

Group 2H-Lakes

matter was determined by differential pulse anodic stripping voltammetry. Conditional stability constants, which represent the mixed stability of all nonlabile ligands in the sample, ranged from 1,600,000 to 1.3 x 10 to the 7th power for the three samples, (Humphers, ISWS) samples. (Humphreys-ISWS) W80-06114

STRATIFICATION OF AEROBIC METHANE-OXIDIZING ORGANISMS IN LAKE MEN-DOTA, MADISON, WISCONSIN, Wisconsin Univ.-Madison. Dept. of Bacteriology. S. M. Harrits, and R. S. Hanson. Limnology and Oceanography, Vol 25, No 3, pt 412-421, May 1980. 3 Fig. 5 Tab, 19 Ref. NSF BMS 75-14012.

Descriptors: *Lakes, *Methane bacteria, *Aerobic bacteria, *Stratification, *Wisconsin, Dissolved oxygen, On-site investigations, Microorganisms, Spatial distribution, Profiles, Nitrogen, Water tem-perature, Laboratory tests, Methodology, Analysis, Data collections, Water sampling, Ecology, Aquat-ic bacteria, *Lake Mendota(WI).

The microflora responsible for methane oxidation are stratified in a narrow band in the thermocline of Lake Mendota where dissolved oxygen is low during summer. Oxygen sensitivity of growth of these organisms or of methane oxidation cannot account for their absence from the epilimnion because oxygen does not inhibit either process under in situ conditions at concentrations exceeding those measured in natural samples. The dissolved inor-ganic nitrogen content of samples where methane oxidation rates were highest was greater than I mg/liter in summer 1977. The authors could not obtain evidence of in situ nitrogen fixation although enrichment cultures grew on nitrogen-free media and fixed 15N2. Nitrite was present at the position in the water column of maximum methane oxidation; this suggests that methanotrophic bacteria co-oxidized ammonia. The distribution of meth-anotrophs in the lake indicated that their position in the water column at each time of year was determined by the concentration profiles of oxygen and methane. Methane oxidation in summer de-pletes the methane in the epilimnion, and the ab-sence of oxygen in the hypolimnion precludes sence of oxygen in the hypolimnion precludes growth of the organisms there. At other times of year the rates of oxidation of methane seem to be determined by the concentration of methane in the water. The rate of oxidation of methane by a sample was increased by additional methane when the in situ concentration was less than 5 microM. (Humphreys-ISWS)
W80-06116

SIZE-SELECTIVE PREDATION, LIGHT TRANSMISSION, AND OXYGEN STRATIFI-CATION: EVIDENCE FROM THE RECENT SEDIMENTS OF MANIPULATED LAKES, Geophysics

J. A. Kitchell, and J. F. Kitchell. Limnology and Oceanography, Vol 25, No 3, p 389-402, May 1980. 8 Fig, 1 Tab, 56 Ref. NSF DEB-7911781.

Descriptors: *Lakes, *Limnology, *Euphotic zone, *Predation, Lake sediments, On-site investigations, Oxygen, Stratification, Daphnia, Zooplankton, Aquatic life, Size, Dissolved oxygen, Water temperature, On-site data collections

In an experiment maintained since 1951, half of a divided lake was limed resulting in a significantly expanded euphotic zone. In both basins native fish were removed and rainbow trout introduced. Quantitative analysis of zooplankton remains preserved in the sediments of both lakes provides evidence of the selectivity of a visually dependent predator at natural and enhanced transparency and oxygen concentrations. The sediment record effectively documents the known manipulations and the tively documents the known manipulations and the expected responses. In the control lake, no significant changes in zooplankton species composition, species dominance, or size-frequency distribution are recorded. In the alkalized lake, a succession in zooplankton dominance from Daphnia pulex to Daphnia rosea to Bosmina is recorded, as is a

IMI

reciprocal change in mean size of D. pulex and D. rosea. The relative position of the thermocline with respect to the oxygen minimum barrier and the light transmission curve accounts for the observed differences in selective predation intensity. By verifying the sensitivity of the sediment record to the results of known manipulations, the authors have presented evidence of a technique equivalent to long term experiments. (Humphreys-ISWS) W80-06118

FLUORESCENCE: ABSORBANCE RATIOS-A MOLECULAR-WEIGHT TRACER OF DIS-SOLVED ORGANIC MATTER, Michigan State Univ., Hickory Corners. W. K. Kellogg Biological Station. For primary bibliographic entry see Field 5B. W80-06134

THE EFFECTS OF TRANSECT DIRECTION ON OBSERVED SPATIAL PATTERNS OF CHLOROPHYLL IN LAKE TAHOE, Univ., Davis. Div. of Environmental

M. R. Abbott, T. M. Powell, and P. J. Richerson. Limnology and Oceanography, Vol 25, No 3, p 534-537, May 1980. 3 Fig, 22 Ref. NSF DEB76-20341, DEB76-11095.

Descriptors: *Lakes, *Water quality, *Chlorophyll, On-site investigations, Spatial distribution, Water sampling, Surveys, Measurement, Methodology, Analysis, Fluorescence, Data collections, Water chemistry, *Lake Tahoe(CA NV).

Horizontal transects of fluorescence measurements have been used extensively to investigate phyto-plankton patchiness. Variance spectra were calculated from these data, thus quantifying spatial hetrogeneity as a function of length scale. Analysis of such field-work and associated theoretical investigations is based on the assumption that borizontal tigations is based on the assumption that horizontal patchiness is isotropic. Three transects done in Lake Tahoe (California-Nevada) in different direc-Lake Tance (Cambrian-Nevaus) in different direc-tions on the same day resulted in variance spectra that were significantly different from each other. The possibility of windrows appears consistent with the spectra. Although the exact cause of the differences was unclear, the results do violate the assumption of isotropic horizontal phytoplankton patterns. (Humphreys-ISWS)
W80-06135

VARIANCE-CONSTRAINED RESERVOIR

CONTROL PROBLEM, IBM Thomas J. Watson Research Center, Yorktown Heights, NY. M. Sniedovich.

Water Resources Research, Vol 16, No 2, p 271-274, April 1980. 4 Tab, 7 Ref.

Descriptors: *Reservoirs, *Reservoir operation, *Water management(Applied), *Model studies, Mathematical models, Equations, Mathematics, Storage, Discharge(Water), Inflow, Hydrology.

A dynamic programing solution procedure was developed for a class of variance-constrained reser-voir control problems. The variance constraint was incorporated as a penalty term in a nonseparable Lagrangian problem that is solved by a two-stage procedure. First, the difficulty associated with the procedure. First, the difficulty associated with the nonseparability of the problem was resolved by the consideration of a modified simpler separable problem that was solved by a simple additive dynamic programing recursion. Then the optimal solution to the nonseparable problem was found by a simple research algorithm. The entire discussion was devoted to the mathematical aspects of the problem, and no consideration was given to the applicability of variance constraints as far as water resources management problems are concerned. The proce-dure was applied to a simple numerical example. (Sims-ISWS)

OPTIMAL OPERATION OF MULTIRESER-VOIR POWER SYSTEMS WITH STOCHASTIC

Institut de Recherce de l'Hydro-Ouebec, Var-For primary bibliographic entry see Field 2E. W80-06146

THE ENTRAINMENT OF COHESIVE SEDI-MENTS IN FRESHWATER, Aerospace Corp., Los Angeles, CA. For primary bibliographic entry see Field 2J. W80-06187

MEAN SUMMER CIRCULATION IN LAKE ONTARIO WITHIN THE COASTAL ZONE, Woods Hole Oceanographic Institution, MA. G. T. Csanady, and J. T. Scott. Journal of Geophysical Reseearch, Vol 85 No C5, p 2797-2812, May 20, 1089. 8 Fig, 1 Tab, 21 Ref.

Descriptors: "Water circultion, "Summer, "Lake Ontario, "Model studies, Mathematical models, Coasts, Lakes, Circulation, Currents(Water), Velocity, Temperature, Water temperature, Sampling, On-site investigations, Advection, Heat transfer, Momentum transfer, Limnology, Coastal circulation.

Arithmetic averages of daily temperature and cur-rent surveys during July-August 1972 were used to define a mean summer costal circulation pattern in Lake Ontario. Some of the important features of Lake Ontario. Some of the important features of this mean flow pattern may be explained by simple equilibrium models of wind-driven flow. Discrep-ancies between these models and coastal zone ob-servations appear to be due mainly to advection of momentum during transient flow episodes, espe-cially those involving the intermittent appearance of full upwelling along the north shore. The south shore flow pattern consists of divegent coastal jets, such as the theoretical steady resource of fricmuch as the theoretical steady response of a fric-tionless two-layer basin to an eastward wind. At the eastern end of the lake a deep current is gener-ated by interface friction below the strong coastal jets. Along the north shore there is no mean coastal jet pattern, and the return flow of warm water must be supposed to be accomplished some dis-tance offshore. (Sims-ISWS)

OCCURRENCE OF A DEEP NITRITE MAXIMUM IN LAKE MICHIGAN, Wisconsin Univ., Milwaukee. Center for Great

J. A. Mortonson, and A. S. Brooks. Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 6, p 1025-1027, June 1980. 1 Fig.

Descriptors: *Lake Michigan, *Nitrities, *Phkyto-plankton, Nitrogen, Nitrogen compounds, Chloro-phyll, Dissolved oxygen, Temperature, Water tem-perature, Ammonia, Lakes, Sampling, Data proc-essing, Limnology, Nitrite maxima.

A nitrite maximum with concentrations up to 10 micrograms NO2(-)-N/L was observed at depths between 30 and 60 m during summer in oxygensaturated waters of Lake Michigan. The extracellular release of nitrite by phytoplankton concentrated below the thermocline appears to account for this maximum. In fall, when phytoplankton were not longer concentrated in this zone, no nitrite maximum was observed. It appears that the deep nitrite maximum in Lake Michigan is found only in association with high densities of phytoplankton. association with high densities of phytoplankton. (Sims-ISWS)
W80-06189

2I. Water In Plants

NITROGEN FIXATION ASSOCIATED WITH FOUR SPECIES OF SUBMERGED ANGLO-SPERMS IN THE CENTRAL CHESAPEAKE

BAY, Maryland Univ., College Park. Dept. of Botany. F. Lipschulta, J. J. Cunningham, and J. C.

Estuarine and Coastal Marine Science Vol 9, p 813-818, 1979. OWRT-A-042-MD(1), 14-34-0001-

8022

Descriptors: *Nitrogen fixation, *Angiosperms, *Chesapeake Bay, *Sounds(NC), Nutrients, Ecosystems, Myriophyllum spicatum, Potamogeton perfoliatus, Ruppia maritima maritima, Eldodea canadensis, Aquatic plants, *Submerged plants.

The rate of acetylene reduction was determined for Myriophyllum spicatum, Potamogeton perfo-liatus, Ruppia maritima and Eldodea canadensis, in a brackish water tributary of Chesapeake Bay. liatus, Ruppia maritima and Eldodea canadensis, in a brackish water tributary of Chesapeake Bay. Ruppia had the highest nitrogen fixation rate on a dry weight basis (66 ng-at. N(g wt h)-1). However the fixation per square meter of creek bottom was highest (16 3 microg-at. N(sq. m H)-1) for Myriophyllum due to its greater biomass. Generally, our low rates are more comparable to those associated with seagrasses in North Carolina, than to many higher rates reported from tropical waters. We postulate that low nitrogen fixation rates are a consequence of the availability of nitrogen either in the water column or sediments of temperate in the water column or sediments of temperate estuaries such as the Chesapeake Bay, and the North Carolina Sounds. W80-06040

NET REAINFALL AND INTERCEPTION LOSS IN A SAVANNA COVER (NETTO REENVAL EN ONDERSKEPPINGSVERLIES IN 'N SA-VANNABEDEKKING).

Durban-Westville Univ. (South Africa) G. du T. De Villiers.

South African Geographer (Dennesig Stellenbosch), Vol 5, No 6, p 465-475, 1977. 6 Fig, 2 Tab,

Descriptors: *Rainfall intensity, *Interception, *Canopy, *Stemflow, *Evaporation, Water loss, Distribution patterns, Vegetatin effects, Forests, Trees, Grasses, Raindrops, Rain gages, Correlation analysis, Regression analysis, Frequency analysis, Variability, Semiarid climates, *South Africa.

The amount of precipitation reaching the ground under a canopy of vegetation is different from the amount measured in the open. The loss of water by the interception of rain by forest vegetation was investigated in a semi-arid area and the parameters affecting interception were determined. Regression analysis and variance analysis were carried out on the data from the experimental zone and a linear relationship between the total amount of precipitation falling on th forest vegetation and the stemflow was found, interception loss was concluded to be a function of vegetation density per surface area and evalporation probabilities. (Sidney-IPA) W80-06091

2J. Erosion and Sedimentation

A NUMERICAL MODEL FOR COMPUTATION OF SEDIMENTATION IN LAKES AND RESER-

VOIRS, Iowa Univ., Iowa City. Inst. of Hydraulic Re-

F. Karim, T. E. Croley, II, and J. F. Kennedy.
Available from the National Technical Information
Service, Springfield, VA 22161 as PB80-204456,
Price codes: Al8 in paper copy, Aol in microfice.
Lowa State Water Resources Research Institute, Iowa State University, Ames. Completion Report No 105, (1979). 409 p. OWRT A-068-IA(1), 14-34-0001-8017.

Descriptors: *Numerical model, *Sedimentation, *Lakes, *Reservoirs, Sediment, Entrapment, Parti-Clastes, Neservoirs, Sediment, Entrapment, Farticle size, Sediment distribution, Compaction, Elevation-area-capacity, Simulation analysis, Prediction, Forecasting, Operation plans, Reservoir type curves, Coralville Lake(IA), Red Rock Lake(IA), Saylorville Lake(IA), Iowa, Computer model SEDRES

A new computer-based numerical model, SEDRES, is developed for the calculation of amounts, rates, and spatial distributions of sediment in lakes and reservoirs. The principal components of SEDRES compute the following: sediment entrapment, distribution, and differential settling for

three different size classes (clay, silt and sand); compaction of currently and all previously deposit-ed sediments; correction to zero elevation for com-paction; sediment slump correction due to compacpaction; seminest stump correction due to compac-tion at zero elevation and at sediment-type inter-faces; alteration of elevation-area-capacity relation due to sedimentation. Inputs to the model are water inflows, reservoir operation levels, original reservoir elevation-area- capacity relation, sedi-ment characteristics, type of sediment-entrapment and sediment-distributin methods. The time-interand sediment-distributin methods. The time-inter-val for simulation may be one week or any multi-ple thereof. SEDRES was applied to predict future sedimentation rates in the Coralville, the Red Rock and the Saylorville Lakes on the Des Moines River, Iowa. Model results were in good agree-ment with the observed data. Results from the 100-year sedimentation simulatin of these three reser-voirs are presented at 5-year intervals for the cur-rent and several alternative operation plans. W80-06012

DISSOLVED OXYGEN IN INTRAGRAVEL WATER OF THREE TRIBUTARIES TO RED-WOOD CREEK, HUMBOLDT COUNTY, CALI-FORNIA.

Geological Survey, Helena, MT. Water Resources

For primary bibliographic entry see Field 4C.

DETERMINATION OF CERIUM IN MARINE

SEDIMENTS, Bhabha Atomic Research Centre, Bombay (India). For primary bibliographic entry see Field 5A. W80-06086

BEDFORM SPACING AND FLOW RESIS-

TANE, Canterbury Univ., Christchurch (New Zealand). Dept. of Agriculatural Engineering. T. R. H. Davies.

Journal of the Hydraulics Division, American Society of Civil Engineers, Vol 106, No HY3, Proceedins paper 15258, p 423-433, march 1980. 3 Fig, 1 Tab, 25 Ref, 2 Append.

Descriptors: *Dunes, *Erosion, *Flow resistane, *Sedimentation, Alluvial channels, Hydraulics, Laboratory tests, Channels, Channel morphology, Rivers, Flow resistance, *Bedforms, Bed ripples, Maximum resistance principle.

The resistance to flow in an alluvial channel de-The resistance to flow in an alluvial channel de-pends mainly on the size, shape, and spacing of the bedforms present, and these in turn depend on the flow depth and velocity. A hypothesis is postular-ed that the nonplanar equilibrium shape of a defor-mable boundary is that which causes a local maximum of resistance to flow. It is besed on the demum of resistane to flow. It is based on the data describing the geometry of stream meanders and of self-formed armored beds, and on figures for the resistane to flow past rectangular rigid roughness elements in channels. Laboratory experimens were elements in channels. Laboratory experimens were made to test the maximum resistane hypothesis. The resuls showed that the spacing/height ratio at which bedforms of a given shape develop maximum resistance to flow corresponds to the spacing/height ratio at which such bedforms occur when formed naturally by the flow of water over sand. The maximum resistane principle, by relating bedform geometry to flow conditions, offers some progress towards understanding the complex interaction between bedforms and flow resistance. (Singh-ISWS)
W80-06096

EVALUATION OF JET-ROOF GEOMETRY FOR SNOW-CORNICE CONTROL, Montana State Univ., Bozeman. Dept. of Civil Engineering and Engineering Mechanics. For primary bibliographic entry see Field 2C. W80-06103

FRACTIONATION OF SEDIMENT OXYGEN DEMAND, Illinois State Water Survey, Peoria. For primary bibliographic entry see Field 5A.

W80-06125

LABORATORY MEASUREMENT OF SEDI-MENT BY TURBIDITY, Western Canada Hydraulic Labs. Ltd. (British Co-

P. R. B. Ward, and R. Chikwanha. P. K. B. Ward, and R. Chikwanna. Journal of the Hydraulics Division, American So-ciety of Civil Engineers, Vol 106, No HY6, Pro-ceedings Paper 15470, p 1041-1053, June 1980. 5 Fig. 3 Tab, 6 Ref, 2 Append.

Descriptors: *Channels, *Sedimentation, *Instrumentation, *Measurement, Clays, Erosion, Floods, Suspended load, Hydrology, Water pollution, Turbidity, *Channel stabilization, Sediment deposits, ded sediment

A low cost light transmission instrument was used to measure the concentration of suspended sediment in river water samples. Problems that have confronted previous workers such as the fast reduction of instrument sensitivity with grain size of sediment were investigated, and the method was shown to be viable. Good performance with acceptable accuracies and very short measuring times were shown to apply for samples in the concentration range 100 mg/L to 2000 mg/L. Sand-sized particles were not measured with the laboratory instrument, although clay- and silt-sized particles were measured satisfactorily. A method was dewere measured satisfactorily. A method was de-scribed of correcting the results for particles that were not measured, applicable to rivers that carry only small proportions of suspended sand. The method was described and tested for laboratory application only, but the findings of the 'Calibra-tion' section may be applied also to field instru-ments that work on the turbidity principle. (Lee-ISWS) W80-06127

A SAMPLER FOR COHESIVE SEDIMENT IN THE BENTHIC BOUNDARY LAYER, University Coll. of Swansea (Wales). Dept. of Chemical Engineering.
For primary bibliographic entry see Field 7B.
W80-06132

A SPATIALLY RESPONSIVE HYDROLOGIC MODEL TO PREDICT EROSION AND SEDI-

MENT TRANSPORT,
Virginia Polytechnic Inst. and State Univ., Blacksburg, Dept. of Agricultural Engineering.
B. B. Ross, V. O. Shanholtz, and D. N.
Contractor.

Contractor.

Water Resources Bulletin, Vol 16, No 3, p 538-545,
June 1980. 2 Fig, 3 Tab, 37 Ref. OWRT A-077VA(7) and A-083-VA(1).

Descriptors: *Sediment transport, *Forecasting, *Computer models, *Finite element analysis, Overland flow, Channel flow, Runoff, Sediments, Land use, Sediment yield.

A finite element numerical model has been devel-A finite element numerical model has been developed by the authors which routes overland and channeled flows in a watershed, given soils, land use, topographic descriptors, and rainfall as input. Such processes as infiltration, canopy interception, seasonal growth of vegetation, and depression storage are described in the hydrologic context of the model. These capabilities, along with the spatial detail and responsiveness of the model, allow a ready adaptation of the model to provide for the prediction of sediment transport and yield. It is prediction of sediment transport and yield. It is assumed that the best results can be obtained by a assumed that the best results can be obtained by a technique which utilizes the following procedures. Sediment yield to the channel is described by functions describing soil detachment by rainfall and overland flow and transport by overland flow. Since the model description of the channel flow processes involves a more realistic representation of the physical drainage system, an attempt was made to define sediment transport in the channel by erosion and sedimentation mechanics. A concentual framework is provided whereby the interceptual framework is provided whereby the inte-grated effects of various land use activities on sediment transport and yield can be evaluated. Inherent in this provision of the model is the capability of determining the effects of any control measures to be implemented on a watershed.

Group 2J-Erosion and Sedimentation

W80-06159

THE ENTRAINMENT OF COHESIVE SEDI-MENTS IN FRESHWATER.

Aerospace Corp., Los Angeles, CA. M. K. Fukuda, and W. Lick. Journal of Geophysical Research, Vol 85, No C5, p 2813-2824, May 20, 15 Fig. 3 Tab, 25 Ref.

Descriptors: *Sediments, *Sediment transport, *Entrainment, *Lake sediments, Laboratory tests, Hydraulic models, Shear stress, Velocity, Flow, Mixing, Settling velocity, Suspended solids, Dispersion, Freshwater, Limnology, Sedimentology, Cohesive sediments.

Presented in this study were experimentally measured characteristics of the entrainment rate and settling speeds of fine-grained, cohesive sediments in freshwater. The investigation focused on three different sediments of varying mineral composition which are representative of the sediments of Lake Erie. The influences of the bulk sediment water content and of the mineral and size composition. content and of the mineral and size composition on the entrainment rate and equilibrium concentration of these suspended sediments were determined. Linear increases in the bulk sediment water content resulted in logarithmic increases in the entrainment rate and equilibrium concentration. For a limited range of shear stresses near that needed to initiate noticeable entrainment the entrainment rate and equilibrium concentration increased logarithand equilibrium concentration increased logarin-mically as the applied shear stress was increased linearly. For larger stresses, linear increases in the applied shear stress caused approximately linear increases in the entrainment rate and equilibrium concentration. At fixed values of water content and shear stress the entrainment rate and equilibrium concentration increased as the clay mineral content of the sediment increased and as the median particle size decreased. Settling speed experiments demonstrated that the median settling speed of the suspended sediment particles in a quiescent fluid increased as the ionic strength of the solution increased. At a fixed ionic strength the settling speed decreased with increased clay mineral content. (Sims-ISWS) W80-06187

BIOMECHANICS OF VEGETATIVE CHAN-NEL LININGS,

Waterloo Univ. (Ontario). Dept. of Civil Engineering.

For primary bibliographic entry see Field 2E. W80-06191

EROSIVITY VALUES FOR INDIVIDUAL DESIGN STORMS,

Science and Education Administration, Boise, ID.

Journal of the Irrigation and Drainage Division, American Society of Civil Engineers, Vol 106, No IR2, Proceedings Paper 15462, p 135-145, June 1980. 4 Fig. 5 Tab, 11 Ref, 2 Append.

Descriptors: *Design storm, *Erosion, *Soil erosion, Rainfall intensity, Rainfall, Conservation, Hydrology, Erosion control, Climatology, Soil conservation, Soil management, *Erosivity index, Design rainfall events, Erosivity.

A method was developed for determining the ero-sive power, R sub st, of individual rainfall events of any selected frequency and duration for any of the four SCS type storms. The method provides an easy, rapid procedure for assessing erosion or pol-lution potential on a storm basis, since sediments themselves are pollutants and are carriers of chemical pollutants. It also allows designers of conservation measures to determine the range of erosion potential that might be encountered and the most critical combination of storm type and soil or ground cover conditions. In some cases, managers could use this method to determine harvest schedules that would minimize erosion losses from the more susceptible fields. (Lee-ISWS) W80-06195

JMI

2K. Chemical Processes

MAJOR GEOCHEMICAL PROCESSES IN THE EVOLUTION OF CARBONATE-AQUIFER SYS-

TEMS, Geological Survey, Reston, VA. For primary bibliographic entry see Field 2F. W80-06031

WATER-QUALITY DATA FROM FIVE OREGON STREAM BA Geological Survey, Portland, OR. Water Resources Div. For primary bibliographic entry see Field 7C. W80-06067

THE EFFECT OF SOIL ACTIVITY ON THE CHEMISTRY OF CARBONATE GROUND-

McMaster Univ., Hamilton (Ontario). Dept. of Ge-

Water Resources Research, Vol 16, No 2, p 381-386, April 1980. 2 Fig, 1 Tab, 32 Ref.

Descriptors: *Groundwater, *Water chemistry, *Carbonates, *Model studies, Mathematical models, Carbon dioxide, Air, Soils, Temperature, Air temperature, Respiration, Calcium, Calcite, Chemistry, Hydrology, Soil activity.

Regional variations in HCO3(-) concentrations of carbonate groundwaters were explained by the combination of a simple ecological model of soil CO2 production and a consideration of the manner in which soil water, soil air, and carbonate materials interact. Carbonate groundwaters in North America were divided into those that have evolved largely under open system conditions and those that have evolved under closed system contionse that have evolved under closed system conditions. The open system group members (with one exception) all come from high latitudes, and it was suggested that recurrent glaciations have acted to replenish soil zone carbonate materials and maintain the soil zone as an important source of dissolved carbonate minerals. (Sims-ISWS) W80-06142

2L. Estuaries

GENETIC AND PHYSIOLOGICAL ADAPTA TION OF THE COPEPOD EURYTEMORA AF-FINIS TO SEASONAL TEMPERATURES. Maryland Univ., Baltimore County, Catonsville. Dept. of Biological Sciences.

P. Bradley. Genetics Vol 90 p 193-205, September, 1978, 5 Tab, 28 Ref. OWRT B-021-MD(3),14-34-0001-6085.

Descriptors: *Copepods, *Eurytemore affinis, Genetic variance, *Temperature tolerance, Physiological variance, Heritability, Offspring-parent regression, Chesapeake Bay.

Evidence of significant additive genetic (genic) variance in temperature tolerance of the copepod Eurytemora affinis was diverived from several sources. Differences were observed between average tolerances of progency of animals exposed and not exposed to heat shock in a power plant. Genic variance was estimated using offspring-parent regressions, full-sib, and half-sib convariances, with gressions, itui-sio, and imit-so one dependence of the quite consistent results. Expressed genic variance between male progeny was always higher than that among female progeny. The pairs of estimates obtained were as follows: female heritabilities first, 0.40 plus or minus 0.09 and 0.84 plus or minus 0.36 half-sibs); 0.20 plus or minus 0.09 and 0.79 plus or minus 0.24 (full-sibs); 0.21 plus or minus 0.45 (full-sibs); 0.28 plus or minus 0.45 (full-sibs); 0.11 plus or minus 0.44 (full-sibs); 0.11 plus or minus 0.44 and 0.72 plus or minus 0.26 (offspring-parent regression). There was no evidence of either nonadditive genetic variance of common environmental (maternal and brood) effects, implying that the genetic variance and brood) effects, implying that the genetic variance was mostly additive and was not maintained because of heterozygous advantage. The presence

of so much genetic variance is surprising in view of the high physiological adaptation found earlier, especially in females. W80-06038

THE MEASUREMENT OF TEMPERATURE TOLERANCE: VERIFICATION OF AN INDEX, Maryland Univ., Baltimore County, Baltimore. Dept. of Biological Sciences.

Dept. of Biological Sciences.

B. P. Bradley.
Limnology and Oceanography, Vol 21, No 4, p 596-599, July 1976. OWRT-A-027-MD(3), 14-31-0001-5020.

Descriptors: *Temperature tolerance, *Copepods, *Eurytemora affinis, Longevity, Index values, *Shock-recovery index, Bays, Estuaries.

A shock-recovery assay for temperature tolerance is demonstrated to predict survival of the copepod Eurytemora affinis at high temperature. The assay can be modified to allow comparison between widely divergent treatment groups W80-06041

DETERMINATION OF CERIUM IN MARINE

SEDIMENTS, Bhabha Atomic Research Centre, Bombay (India). For primary bibliographic entry see Field 5A. W80-06086

ORGANIC-RICH COLLOIDAL MARERIAL IN ESTUARIES AND ITS ALTERATION BY CHLORINATION, Maryland Univ., College park. Dept. of Chemis-

For primary bibliographic entry see Field 5A. W80-06093

THE ANNUAL CYCLE OF PLANKTON DIATOM GROWTH AND SILICA PRODUCTION IN THE INNER OSLOFJORD, OSIO Univ. (Norway). Dept. of Marine Biology

and Limnology.

E. Paasche, and I. Ostergren.

Limnology and Oceanography, Vol 25, No 3, p 481-494, May 1980. 10 Fig. 4 Tab, 36 Ref.

Descriptors: *Fjords, *Plankton, *Silica, Descriptors: "Fjords, "Plankton, "Silica, "Dia-toms, On-site investigations, Aquatic life, Sam-pling, Analysis, Analytical techniques, Distribu-tion, Profiles, Nitrogen, Nitrates, Laboratory tests, Aquatic environment, Data collections, Foreign research, Productivity, "Norway, "Oslofjord(Norway), Biogenic silica.

Concipord(Norway), Biogenic silica.

Concentrations of amorphous particulate silica floigenic silica) in the uppermost layer of the inner Oslofjord, Norway, varied between 2 and 324 micrograms Si/liter over a 1-year period in 1977-1978. Most of the silica was present in frustules of living or dead diatoms, but there was always a certain amount (up to about 50 micrograms Si/liter) in a form that could not be recognized under the microscope. Silica was produced mainly during three large blooms of Skeletonema costatum in February-March, May, and June. At the peak of the June bloom, there was up t 20 times more Si present as diatom silica than as dissolved orthoslicica acid. Uptake experiments in June indicated depletion times of dissolved Si as short as 3 h. Although the S. costatum cells were less heavily silicified in May and June than in February-March, they showed no morphological signs of a drastic Si shortage. (Humphreys-ISWS)

DISTRIBUTION OF OXYGEN IN MARINE SEDIMENTS MEASURED WITH MICROELECTRODES,

Aarhus Univ. (Denmark). Inst. of Ecology and Genetics.

Oceanus. N. P. Revsbech, J. Sorensen, T. H. Blackburn, and J. P. Lomholt. Limnology and Oceanography, Vol 25, No 3, p 403-411, May 1980. 6 Fig. 1 Tab, 22 Ref.

Descriptors: *Dissolved oxygen analyzers, *Oxidation-reduction potential, *Sediments, *Laboratory

tests, Oxygen, Assay, Analysis, Analytical techniques, Oxidation, Cores, On-site investigations, Methodology, Sampling, Data collections, Spatial distribution, *Marine sediments, Oxygen profiles, Amperometric assay

Membrane-covered platinum electrodes with a tip Membrane-covered platinum electrodes with a tip diameter of 2-8 micrometers were used for an amperometric assay of dissolved oxygen in marine sediments. The oxygen profile extended to 3-5 mm depth in nonilluminated sediment; even at high light intensities and at low temperatures it did not extend below 10-mm depth in a homogeneous sandy sediment. Oxygen profiles recorded during light-dark cycles were used to estimate the rates of light-dark cycles were used to estimate the rates of oxygen production and consumption and also to calculate the apparent diffusion coefficient for oxygen in the sediment. Apparently macrofaunal activity, rather than molecular diffusion and water turbulence, was important for the occasional transport of oxygen into deeper layers and thus for the provision of oxidized conditions (positive redox potential) down to 5-10 cm below the sediment surface. (Humphreys-ISWS)
W80-06117

MIXING AND CIRCULATION IN THE NORTHWESTERN GULF OF ST. LAWRENCE; A STUDY OF A BUOYANCY-DRIVEN CURRENT SYSTEM,

Bedford Inst. of Oceanography, Dartmouth (Nova

Scotia). C. L. Tang. Journal of Geophysical Research, Vol 85, No C5, p 2787-2796, May 20, 1980. 14 Fig, 1 Tab, 25 Ref, 1

Descriptors: *Mixing, *Water circulation, *Currents(Water), *St Lawrence River, Current meters, Circulation, Temperature, Salinity, Buoyancy, Spatial distribution, Gulfs, Estuaries, Sampling, Data processing, Hydrography, *Gulf of St

Mixing and circulation near the entrance of the St. Lawrence estuary were studied by using the hydrographic and current meter data obtained in the summer of 1978. It was found that the currents in the upper 40 m are mainly buoyancy driven. As the low salinity water from the estuary flows east-ward and encounters the more saline Gulf of St. Lawrence water, a wedge-shaped layer of low salinity water and a density front are formed. Insalinity water and a density front are formed. Intense vertical mixing takes place along the boundary of the layer. The geostrophic current associated with the front flows southward and, upon reaching the shore, turns east. From there on it flows parallel to the coast and is reinforced by a basin-wide cyclonic gyre forming a strong coastal jet, the Caspe current. The salinity front divides the deep water into the two flow regimes. Eastward (westward) of the front the currents in the 40- to 100-m depth are cyclonic (anticyclonic). The variability of the temperature and salinity fields was examined. The effect of the variability on the interpretation of the data was discussed. (Sims-1SWS) (Sims-ISWS) W80-06122

M2 TIDAL EFFECTS IN GREATER COOK

M2 TIDAL EFFECTS IN GREATER COOK STRAIT, NEW ZEALAND, State Univ. of New York at Stony Brook. Marine Sciences Research Center. M. J. Bowman, A. C. Kibblewhite, and D. E. Ash. Journal of Geophysical Research, Vol 85, No C5, p. 2728-2742, May 20, 1980. 21 Fig. 2 Tab, 52 Ref, 1 Append. NSF-INT 78-01159, NSF 77-26970.

Descriptors: *Tides, *Continental shelf, *Tidal effects, *Water circulation, *Model studies, Mathematical models, Sediments, Water levels, Circulation, Currents(Water), Tidal energy, Topography, Bathymetry, Stratification, Oceanography, *Cook Strait(NZ), *New Zealand, Tidal amplitudes, Tidal

The application of an M sub 2 nonlinear numerical tidal model to the shelf seas of central New Zealand (approximately 38,500 sq km area) was described. It has provided a preliminary assessment of tidal and residual currents, bottom stress, energy

dissipation, and the stratification index. The existdissipation, and the stratification index. The existence of a permanent, tidally driven mesoscale eddy
(approximately 75 km diameter) was predicted
north of D'Urville Island. Large spatial gradients
in bottom stress qualitatively agreed with many
features of the surficial sediment distribution. A
comparison of all available bulk stratification data
with the h/cu u stratification index clearly demonwith the n/cu u stratification index clearly demonstrated the dominance of tidal vs. wind mixing over the control of summer stratification. A potential application of the model to fisheries science was suggested through a comparison of the stratification index contour map and some observations of squid fishing vessel locations. (Sims-ISWS) W80-06123

RELATIONSHIPS BETWEEN HETEROTRO-PHIC BACTERIA AND POLLUTION IN AN INDUSTRIALIZED ESTUARY, Hull Univ. (England). Dept. of Plant Biology. For primary bibliographic entry see Field 5B. W80-06126

EXPERIMENTS ON ARRESTED SALINE

WEDGE, North East London Polytechnic (England). Dept. of Civil Engineering. J. P. Grubert.

J. P. Grubert.

Journal of the Hydraulics Division, American Society of Civil Engineers, Vol 106, No HY6, Proceedings Paper 15484, p 945-960, June 1980. 18

Fig. 18 Ref. 2 Append.

Descriptors: *Estuaries, *Diffusion, *Model studies, Diffusivity, Saline water-freshwater interfaces, Saline water intrusion, Hydraulics, Stratified flows, Waves(Water), Mixing, Froude number, Reynolds number, Saline wedge, Interfacial mixing layer.

Experimental results were presented that show that the onset of interfacial wave breaking can be expressed by a stability parameter that is a function of the interfacial Reynolds number. This parameter was shown to be independent of the flow Reynolds number upstream of a salt wedge and can be scaled to give a stability parameter for prototype flows. Measurements of the rate of mixing at the interface proved that mixing theory based on momentum exchange of turbulent flows is valid as a working hypothesis, and that this mixing is inversely proportional to the relative density. (Lee-ISWS)

SAMPLER FOR COHESIVE SEDIMENT IN THE BENTHIC BOUNDARY LAYER, University Coll. of Swansea (Wales). Dept. of Chemical Engineering.
For primary bibliographic entry see Field 7B.
W80-06132

ANALYSIS OF ORGANIC CARBON IN MARINE SEDIMENTS, Rhode Island Univ., Kingston. Graduate School of Oceanography.
For primary bibliographic entry see Field 5A.
W80-06133

ROLE OF ADVECTIVE TERMS IN TIDALLY GENERATED RESIDUAL CIRCULATION Institute of Ocean Sciences, Sidney (British Co-

Institute of Journal of the Journal of T. S. Murty, F. G. Barber, and J. D. Taylor. Limnology and Oceanography, Vol 25, No 3, p 529-533, May 1980. 6 Fig, 20 Ref.

Descriptors: *Tidal waters, *Water circulation, *Inlets(Waterways), *Model studies, Path of pol-lutants, Tidal effects, Estuaries, Mathematical models, Flow characteristics, Coriolis force, Nu-merical analysis, Analytical techniques, Analysis, *British Columbia, *Masset Inlet.

Through the use of a numerical model, the role of Inrough the use of a numerical model, the role of the nonlinear advective terms in tidally generated residual circulation was explicitly demonstrated. This type of motion has been neglected in compu-tations of dispersion and spreading of surface con-

taminants. The numerical model used was based on transports rather than currents and had been moditransports rather than currents and had been modified in various ways in a number of earlier applications (e.g., Murty and Taylor, 1975); here it was modified, after Greenberg (1977), to incorporate the advective terms. As Murty and Taylor (1975) noted, the numerical approach is quite simple and easily adaptable to any water body. (See also W76-10420 and W78-07116) (Humphreys-ISWS) W80-06136

ON THE HYDROGRAPHY OF SHELF WATERS OFF THE CENTERAL TEXAS GULF COAST, Harbor Branch Foundation, Inc., Fort Pierce, FL.

N. P. Smith. Journal of Physical Oceanography, Vol 10, No 5, p 806-183, May 1980. 7 Fig. 8 Ref. AA550-CT6-150-

Descriptors: "Hydrography, "Continental shelf, "Salinity, "Water temperature, "Texas, "Guld of Mexico, Sampling, On-site investigations, Surveys, Data processing, Variability, Spatial distribution, Temporal distribution, Seasonal, Temperature, Coasts, Oceanography, "Shelf waters, "Texas Gulf Coast."

Temperature and salinity data from 1976 and 1977 Temperature and salinity data from 1976 and 1977 were used to describe low frequency hydrographic variations in Gulf of Mexico shelf waters off the central Texas coast. Data from 23 approximately monthly cruiese define the annual cycle and suggest annually recurring seasonal events, Minimum salinitis occur in late spring, when values decrease to as low as 18 parts per thousand over the inner shelf. Inner shelf salinities during the rest of the year average 31-32 parts per thousand. Surface salinities over the outer shelf may decrease to 32-33 parts per thousand in late spring, but deviate little from 36 parts per thousand at other times. little from 36 parts per thousand at other times. Both the mean salinity and the standard deviation suggest that freshwater runoff effects are restricted suggest that treshwater runoit effects are restricted largely to inner and mid-shelf waters, within 30 km of the coast. Highest annual surface temperatures are 28-20 C across the shelf in late summer. Lowest temperatures in February range from 12-13 C over the inner shelf to 20-21 C over the outer shelf, minima appear to be highly dependent on the severity of the winter season in a given year. Pottoe temperatures are recognized by the agent. Bottom temperatures are dominated by the annual cycle over the inner shelf. Near-bottom temperatures over the outer shelf vary over shorter time intervals and cannot be resolved by monthly sampling. (Sims-ISWS) W80-06183

DOWNWELLING OVER THE SOUTHERN CALIFORNIA SHELF, Scripps Institution of Oceanography, La Jolla, Ca. C. D. Winant.

Journal of Physical Oceanography, Vol 1-799, May 1980. 13 Fig, 15 Ref. NSF OCE78-19295.

Descriptors: *Water circulation, *Coasts, *Storms, *California, Continental shelf, On-site investigations, Currents(Water), Circulation, Temperature, Water temperature, Winds, Pressure, Atmospheric pressure, Oceanography, Meteorology, *Downwelling, Tropical storms.

Costal downwelling events, induced by tropical storms which travel up along the coast, occur regularly during the summer over the shelf of Southern California. Large vertical velocities (0.5 cm/s) were observed over the very narrow (3.6 km) shelf. Simultaneous observations of longshore km) shelf. Simultaneous observations of longshore current and cross pressure gradient indicated that the cross-shelf momentum balance is geostrophic. Heat balance computations revealed that the increase in mean temperature over the shelf is mostly caused by cross-shelf advection of heat. longshore accelerations occurring simultaneously at all depths in the shallower part of the shelf may be explained by longshore seas surface slopes contributing, along with the wind stress, to the longshore momentum balance. Profiles of temperature, along with the wind stress, to the longshore mementum balance. Profiles of temperature and velocity are consistent with a two-layer description of the vertical structure, these layers being separated by a tical structure, these layers being separated by a thin, turbulent mixing layer. (Sims-ISWS)

Group 2L—Estuaries

W80-06184

ESTUARINE FRONT FORMATION AND PROPAGATION, North East London Polytechnic (England). Dept.

of Civil Engineering. J. P. Grubert.

Journal of the Hydraulics Division, American Society of Civil Engineers, Vol 106, No HY6, Proceedings Paper 15485, p 961-975, June 1980. 11 Fig. 15 Ref. 2 Append.

Descriptors: *Saline water-freshwater interfaces, Stratified flow, "Estuaries, "Model studies, Mathematical models, Hydraulic models, Flow, Saline water, Salinity, Density, Tides, Tidal waters, Coasta, Coastal engineering, Estuarine fronts.

Front conditions associated with estuarine saline Front conditions associated with estuarine saline wedges were investigated both theoretically and experimentally. It was deduced theoretically that two distinct front types should exist in a salt wedge estuary, namely wave fronts and St. Venant fronts. When the salt wedge is advancing in its ambient fluid on the flood tide, a wave front exists characterized by a vertical wall of water. On the ebb flow, however, when the salt wedge is retreating in its ambient fluid, a St. Venant front should occur characterized by zero depth at the front. Expericharacterized by zero depth at the front. Experi-ments confirmed that these two front types do occur, but due to stability constraints their frontal conditions are different from those predicted by theory. It was deduced that the fronts of all salt wedges effectively end at the critical flow section and that this should be the front criterion upon which a mathematical model of a salt wedge estu-ary is based. (Sims-ISWS) W80-06194

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

SOLAR POWERED ELECTRODIALYSIS -PART I: DESIGN OF A SOLAR POWERED ELECTRODIALYSIS SYSTEM FOR DESALT-ING REMOTE, BRACKISH WATER SOURCES.

Indics, Inc., Watertown, MA.

Available from the National Technical Information
Service, Springfield, VA 22161 as PB80-203805,
Price codes: A08 in paper copy, A01 in microfiche.
Report Prepared for Office of Water Research and Technology, Dec 1979, 161 p, 62 exhibits. OWRT C-80350-S(8576)(1). 14-34-0001-8576.

*Desalination, *Solar power, *Brackish water, Membrane processes, Voltaic cells, Water supply remote locations, Desalting costs.

An evaluation was undertaken of alternative designs of a solar powered electrodialysis (SPED) system for a desalting application that is typical of the brackish water sources in the southwestern United States. The designs are evaluated relative to total water costs for an average water production of 4,000 gallons per day where the solar isolation of 4,000 gallons per day where the solar isolation averages 24 million joules per square meter per day (10 hours of collection) and the feed water contains 2,200 parts per million of dissolved solids. The optimal design, at current F.O.B. costs for a photovoltaic (PV) array of \$10 per peak watt, minimizes the electrical storage requirements by matching the electrical duty of the desalting plant to the electrical output of the PV array. Including the requirements for well pumping (200 foot depth), the total water cost is \$13.90/Kgal. At \$5 per peak watt, the water cost drops to \$12.00/Kgal. At \$5 per peak watt, the water cost for the SPED plant and a generator powered plant are equal when the and a generator powered plant are equal when the cost of fuel at location is \$1.70 per gallon. Diagrams of the plant layout, process flow sheet and control circuit are included. W80-06001

UMI

DESALTING HANDBOOK FOR PLANNERS.
Catalytic, Inc., Philadelphia, PA.
Available from the National Technical Information
Service, Springfield, VA 22161 as PB80-202518,
Price codes: A13 in paper copy, A01 in paper
copy. Office of Water Research and Technology
Report OWRT TT/80-3 Second Edition, September 1979, 321 p, 94 Fig, 21 Tab, 41 Ref. 14-34-0001-8701

Descriptors: Desalination plants, *Desalination processes, Water supply, Water costs, Economics, *Planning, Evaluation, *Pesearch and development, Distillation, Flash distillation, Electrodialysis, Reverse osmosis, Freezing, Ion exchange, Pretreatment(Water), *Estimated costs, *Design criteria, Construction, Waste water treatment.

This revised Handbook has extensive updating of text material and cost curves, primarily resulting from the most currently published literature from the Office of Water Research and Technology (OWRT). All chapters of this Handbook have been comprehensively revised to reflect latest technolorgy and most recent costing information available to the desalting field. Major sources of data are referenced in the Handbook. Data together with background information and input from OWRT is compiled in a form suitable for water planner's use. The Handbook has been prepared for use in preliminary planning as a source of up-to-date infor-nation on the state of development, costs, econom-ics, and applicability of those desalting processes which are available for providing water supply. It is anticipated that the Handbook will fill a particular need in conducting Western U. S. Water Plan Studies. The Handbook is not meant to substitute for the thorough engineering and economic analy-sis that should precede the decision to build a desalting plant. W80-06013

PROCESS FOR RECOVERY OF CHEMICALS FROM SALINE WATER, Ecodyne Corp., Lincolnshire, IL. (Assignee).

Leconyle Cofp., International Conference of the Cofficial Carette of the United States Patent Office, Vol 989, No 4, p 1399, December 25, 1979.

Descriptors: *Patents, *Waste water treatment, *Saline water, *Desalination processes, Demineralization, Separation techniques, Desalination wastes, Potable water, Hardness(Water), Byproducts, Product recovery.

A continuous process is used to recover most A continuous process is used to recover most of the sodium, magnesium, calcium, potassium, chlo-rine, bromine and sulfate present in saline water, particularly desalination plant by-product brine so-lutions. In addition, most of the water in the saline water feed may be recovered as potable water. In the process, a saline water feed is initially treated to remove essential all, 99% or more, of the magnesium and calcium in the form of salable comnesium and calcium in the form of salable com-pounds. Significant quantities of potable water are obtained during various steps of the process, pri-marily as vapor condensate during the crystalliza-tion steps. The principal advantages of the inven-tion are the ability to exonomically recover as commercially salable compounds virtually all of the principal mineral and chemical constituents found in saline water and to simultaneously recover virtually of the water in the feed as potable water. These results are achieved as a result of the synergistic processing sequence of the invention. This processing sequence removes hardness at the Inis processing sequence removes naraness at the beginning and permits clean, unscaled operating during the remaining steps. The processing sequence effectively precludes the formation of large quantities of the complexes and studges which might tie up the valuable chemical constituents and significantly impair their recovery. (Sinha-OEIS) W80-06176

REFRIGERATION TYPE WATER DESALINI-SATION UNITS, Auscoteng Pty Ltd., Rose Park (Australia). (As-

signee). N. L. Foley

U.S. Patent No 4,181,577, 6 p, 2 Fig, 6 Ref; Official

Gazette of the United States Patent Office, Vol 990, No 1, p 241, January 1, 1980.

Descriptors: *Patents, *Desalination, *Demineralization, *Separation techniques, Refrigeration, Evaporation, Condensation, Heat exchangers, Evaporators, Condensers.

In a water distillation system the heat supplied to the evaporator and the cooling of the condenser is provided by a refrigeration unit having its condensing coils in the evaporator and its evaporative coils in the condenser. To achieve the production coils in the condenser. To achieve the production of water which has its saline content removed, the invention comprises a feed control which maintains a regulated height of the feed water in an evaporator. This evaporator is connected to a condenser so that a flow of vapor can take place from the evaporator to the condenser. The condenser in turn has means to draw-off the liquified distillate for its intended use. (Sinha-OEIS) W80-06178

3C. Use Of Water Of Impaired Quality

STORAGE OF FRESHWATER IN SALINE AQUIFERS.

Harvana Agricultural Univ., Hissar (India). Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 4B.
W80-06022

3D. Conservation In Domestic and Municipal Use

THE RESPONSE OF ILLINOIS MUNICIPAL WATER SYSTEMS TO A PROLONGED PERIOD OF DROUGHT, Illinois Univ. at Urbana-Champaign. Dept. of Ag-ricultural Economics. For primary bibliographic entry see Field 2E. W80-06079

3E. Conservation In Industry

RESEARCH ON NOVEL SOLVENT EXTRAC-TION SYSTEMS FOR INDUSTRIAL WATER REUSE.

Bend Research, Inc., OR.
For primary bibliographic entry see Field 5D.
W80-06032

INDUSTRIAL WATER REUSE WITH COUP-LED TRANSPORT MEMBRANES.

Bend Research, Inc., OR.
For primary bibliographic entry see Field 5D.
W80-06033

3F. Conservation In Agriculture

NEW IRRIGATION SYSTEM DESIGN FOR MAXIMIZING IRRIGATION EFFICIENCY AND INCREASING RAINFALL UTILIZATION, Texas A and M Univ., Lubbock. Agricultural Research and Extension Center.

W. M. Lyle, and J. P. Bordovsky.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-202898, Price codes: A05 in paper copy, A01 in microfiche. Texas Water Resources Institute, Texas A and M University Project Technical Completion Report TR-105, May 1980, 68 p., 30 Fig. 11 Tab, 30 Ref. OWRT A-041-TEX(1). 14-34-0001-7092, 8046 and 9046.

Descriptors: *Irrigation systems, Design criteria, Water savings, Energy savings, Low energy-precision application system, Drop tubes, Orline controlled emitters, Furrow irrigation, Sprinkler irrigation, Water conservation, *Texas high plains.

A new concept in irrigation system design, which has the potential of significant savings in both

WATER QUANTITY MANAGEMENT AND CONTROL—Field 4

Control Of Water On The Surface—Group 4A

water and energy requirements, has been developed and is under evaluation. The system is characterized by and has been labeled a low energy-precision application (LEPA) system, which rather precision application (LEPA) system, which rather than spraying water into the air at moderate to high pressures, distributes it directly to the furrow at very low pressure through drop tubes and ori-fice controlled emitters. This occurs as the system continuously moves through the field in a rectilinear fashion. The system is used in conjunction with micro-basin land preparation which also optimizes the utilization of rainfall. The combined system minimizes the effect of soil and climatic variables which adversely influence furrow and sprinkler irrigation efficiencies. Significant savings of both water and energy resources are indicated from water and energy resources are indicated from results of the limited testing to date.

TENSIOMETER-CONTROLLED MEDIUM FREQUENCY TOPSOIL IRRIGATION: A TECHNIQUE TO IMPROVE AGRICULTURAL WATER MANAGEMENT,

Navorsingsinstituut vir Grond en Besproeiing, Pretoria (South Africa).

Water SA (Pretoria), Vol 4, No 3, p 134-155, 1978. 18 Fig, 4 Tab, 16 Ref.

Descriptors: *Tensiometers, *Irrigation practices Descriptors: "Lensiometers, "Irrigation practices, "Soil management, "Distribution patterns, Soil chemical properties, Salinity, Moisture content, Water conservation, Soil moisture, Evaporation control, Seasonal, Leaching, Evapotranspiration, Irrigation effects, Sprinkler irrigation, Mist irrigation, Surface irrigation, Crop production, Crop response, Agriculture, "South Africa.

Tensiometer-controlled irrigation mangement was investigated to prevent over-irrigation and under-irrigation which induced soil salinization and to obtain the highest yield per unit water during short term water scarcity. The technique was tested in term water scarcity. The technique was tested in South Africa and citrus under drip irrigation at Zebediela, on wheat and soybeans under drip and microjet irrigation near Pretoria. Medium frequency irrigation was employed to keep the soil moisture in the tip of 0.045 m layer at a high water potential and the moisture in the subsoil at a low water potential. Irrigation water management was most critical during certain development stages in the plant growth such as germination and flowing. most critical uting certain development stages in the plant growth such as germination and flowing. Moisture retention curves were drawn for three layers of four soils and tensiometer graphs depict-ing moisture withdrawal and replenishment were derived for each of the irrigation areas. Tensiometer data were shown to be quantitatively useful and accurate in irrigation management. Disadvan-tages may include variations in reading due to careless installation, critical placement of the tencarriess instantation, critical placement of the en-siometer for accurate readings, and a time lag between irrigation and the correct tensiometer reading. (Sidney-IPA) W80-06070

CENTER PIVOT CONSTRUCTION FOR CENTER PIVOT SPRINKLER,
Irrigation and Power Equipment, Inc., Greeley,

CO. (Assignee).

CU. (Assignee).
R. E. Hunter, and R. C. Shook.
U.S. Patent No. 4,180,092, 10 p, 9 Fig, 7 Ref;
Official Gazette of the United States Patent Office,
Vol 989, No. 4, p 1255, December 25, 1979.

Descriptors: *Patents, *Irrigation, *Irrigation systems, *Application equipment, Irrigation operation and maintenance, Irrigation efficiency.

An improved center pivot for a self-propelled center pivot irrigation system is disclosed. It is characterized by a vertical vipot pipe supported for rotational movement at both the upper and lower extremities. Additionally, the gasket assembly providing leak-proof rotational movement of the pivot pipe relative to a fixed supply pipe is characterized by a slideable casing which can be moved from a normal operating position, where the fixed supply pipe and the rotating pivot pipe are bridged by the casing with gaskets placed between mating surfaces, and a second non-bridged position where the gaskets are removable

so as to allow replacement of worn gaskets without moving or removing any of the major pipe components of the sprinkler system. A strain relief assembly is carried by the casing and connectable to a conduit pipe extending the length of the pivot pipe to a packing gland through which the conduit pipe passes to connect to a collector ring assembly. (Sinha-OEIS)

WATER SPRINKLER, k. E. DeWitt. U.S. Patent No 4,180,210, 16 p 11 Fig, 7 Ref; Official Gazette of the United States Patent Office, Vol 989, no 4, p 1295, December 25, 1979.

Descriptors: *Patents, *Irrigation, *Sprinkler irrigation, Application equipment, Flow control, Irrigation efficiency, Irrigation operation and maintenance, Nozzles.

A water sprinklr is described for developing predetermined but variable patterns of water coverage. The sprinkler includes pattern-defining apertures which are contoured in accordance with desired patterns of wate coverage to pass varying but predetermined amounts of water as a sprinkler nozzle rotates. A sampling aperature progressively samples the outputs of selected pattern-defining apertures in synchronism with the rotation of the sprinkler nozzle so as to conform the water output of the nozzle to that of the desired pattern of water coverage. (Sinha-OEIS) W80-06174

METHOD OF COVERING CORRUGATED DRAINAGE TUBES,

U.S. Patent No 4,180,464, 4 p, 2 Fig, 7 Ref; Official Gazette of the United States Patent Office, Vol 989, no 4, p 1375, December 25, 1979.

Descriptors: *Patents, *Irrigation, *Drainage systems, *Pipes, Protection, Irrigation operation and maintenance, Irrigation efficiency.

The drainage pipe industry has developed new types of flexible corrugated drainage and irrigation tubing where the wall includes alternating annular peaks and valleys and peripheral slotted openings arranged tranversely to the longitudinal axis of the tube. A sheet of flexible water-repellent material may be placed over the area of the tube in which may be placed over the area of the tube in which the slotted openings are located. Alternatively a sheet of fine filtering material may be used instead of the water-repellent material. This invention provides an improved an improved sleeve which completely encircles in the flexible drainage pipe with a cylindrical or tubular length of relatively elastic, knit fabric material. The sleeve is of a diameter, in the relaxed condition, less than the diameter of the drainage tube. Due to the inherent elasticity of the knit fabric, the tubular sleeve provices a corrugated flexible drain pipe with a protective covering control to the thouar steeve provices a corrugation of fine the seasily assembled on the pipe. Moreover, during transportation and movement of the pipe in the field, the sleeve will remain snugly in place, generally conforming to the configuration of the pipe, thereby preventing damage to the sleeve. (Sinha-OEIS)

SELF-PROPELLING WATERING APPARA-

Di Palma Irrigation S.A., Cavalle (France). (As-

signee).
J-C. Moisan.
U.S. Patent No 4,181,257, 23 p, 15 Fig, 8 Ref;
Official Gazette of the United States Patent Office,
Vol 990, No 1, p 136, January 1, 1980.

Descriptors: *Patents, *Irrigation, *Irrigation systems, Lateral conveyance structures, Irrigation op-eration and maintenance, Application equipment, Irrigation efficiency.

A mobile watering apparatus has a framework which is provided with wheels and supports a watering nozzle as well as a drum forming rotary magazine for a pipe, one end of which is connected

to the nozzle. The other end of the pipe, leaving the drum, is adapted for connection to a water supply station on the land. A hydraulic motor, actuated by water under pressure, allows the traveling of the apparatus and the joint winding of the pipe on the drum, with however, a slip clutch in the second case. This slip clutch is preferably controlled by a means responsive to the tension being exerted on the pipe. (Sinha-OEIS)

DRAIN DEPTH AND SUBIRRIGATION IN LAYERED SOILS,
North Carolina State Univ. at Raleigh. Dept. of Biological and Agricultural Engineering.
Y. K. Tang, and R. W. Skaggs.
Journal of the Irrigation and Drainage Division, American Society of Civil Engineers, Vol 106, No IR2, Proceedings Paper 15457, p 113-122, June 1980. 6 Fig. 1 Tab, 15 Ref, 1 Append.

Descriptors: *Subsurface irrigation, *Subsurface drainage, *Soil water movement, *Model studies, Mathematical models, Drains, Tile drains, Subsurface drains, Irrigation, Soils, Soil types, Hydraulic conductivity, Subsurface flow, Irrigation practices, Irrigation efficiency, Agriculture.

The Richards equation for two-dimensional saturated-unsaturated water movement was solved for subirrigation from buried drains in layered soils. Numerical solutions were obtained for soils that have subsurface layers with high hydraulic conductivities. Results showed that increasing the drain depth so that it approaches or penetrates a high conductivity bottom layer will reduce head high conductivity bottom layer will reduce head loss due to convergence near the drain. Deeper drains significantly increased subirrigation rates for deep soils and narrow drain spacings but had a smaller effect for shallow profiles and wide spac-ings. The response to deeper drains also increased with hydraulic conductivity and thickness of the bottom layer. The results showed that the drain should be placed at the interface of the high con-ductivity layer when possible. Further increases in the depth of the drain did not result in significant increases in subirrigation rate or water table rise. (Sims-ISWS)

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

HYDROLOGY OF JUMPER CREEK CANAL BASIN, SUMPTER COUNTY, FLORIDA, Geological Survey, Tallahassee, FL. sources Div.

A. Anderson.

Available from the OFSS Box 25425, Fed. Ctr.

Denver Co 80225, paer copy \$5.75, microfiche
\$3.50. Geological Survey open-file report 80-208

(WRI), 1980. 41 p, 11 Fig. 4 Tab, 6 Ref.

Descriptors: "Hydrology, "Canals, "Watersheds(Basins), "Florida, "Evaluation, Effects, Streamflow, Rainfall, Flood control, Surface runoff, Evapotranspiration, Aquifers, Potentiometric level, Water levels, Surface waters, Groundwater, Water quality, Planning, Channels, Excavation, *Jumper Creek Canal basin(FL). *Sumter County(FL).

Jumper Creek Canal basin in Sumter County, Flor-Jumper Creek Canal basin in Sumter County, Florida, was investigated to evaluate the overall hydrology and effects of proposed flood-control works on the hydrologic regiment of the canal. Average annual rainfall in the 83-square mile basin is about 53 inches of which about 10 inches runs of the canal. off in the canal. Average annual evapotranspiration is estimated at about 37 inches. Pumping from limestone mines has lowered the potentiometeric surface in the upper part of the basin, but it has not significantly altered the basin yield. Channel excavation to reduce flooding is proposed with seven

Field 4-WATER QUANTITY MANAGEMENT AND CONTROL

Group 4A-Control Of Water On The Surface

control structures located to prevent overdrainage. The investigation indicates that implementation of the proposed plan will result in a rise in the potentiometric surface n the upper basin, a reduction is surface outflow, an increase in subsurface outflow, an increase in the gradient of the potentiometeric an increase in the gradient of the potentiometeric surface of the Floridan aquifer, an increase in leakage from the canal to the aquifer in the upper basin, and an increase in the magnitude of flood flows from the basin. Ground water in Jumper Creek basin is a bicarbonate type. Very high concentrations of dissolved iron were found in shallow wells and in some deep wells. Sulfate and strontium were relatively high in wells in the lower basin. (Kosco-USGS)

WATER FROM THE WATERSKLOOF, Department of Water Affairs, Pretoria (South Africa). For primary bibliographic entry see Field 8A.

W80-06073

COPING WITH THE ONE-IN-TEN-YEARS STORM.

The South African Sugar Journal. Vol 63, No 3 p 113, March 1979, 1 Fig

Descriptors: *Channels, *Drainage systems, *Flood control, *Water control, *Grassed waterways, Soil erosion, Surface runoff, Crop producways, Soil eroson, Saince tunni, Ctop produc-tion, Channel improvement, Excavation, Flood routing, Floodways, Open channels, Surface drain-age, Land forming, *South Africa, *Watershed

The construction of large grassed waterways in the Western Transvaal maize belt of South Africa is helping to get rid of annual flood waters, keep soil on the farms, and increasing crop yields by up to 200% over previous years. The area, which supports vast fields of maize, is almost flat and apparently devoid of natural drainage systems. The natural waterways that did exist have been planted or built on. In the seasons of 1975, 1976, 1977, and 1978, flooding was extensive with some areas get-1976, Rooding was extensive with some areas get-ting over 800 mm of rain, resulting in crop failure and severe erosion. To solve this problem, the farmers, the Provincial Administration, commer-cial and industrial firms, and the staff of the De-partment of Agricultural Technical Services, all cooperated to construct waterways. Aerial photographs and physical contour surveys were used to determine the locations for the waterways. In order to cope with the once-in-ten-year storm, some waterways will be up to 35 kilometers long and 100 meters wide, with an average depth of 300 mm. Soil that was excavated was dumped in the center creating two waterways, making the water easier and safer to handle. Divesions, culverts, and bridges were also constructed for roads and bridges were also constructed by loans to be constructed to more rapidly direct the runoff into the waterways which will be grass covered. (Seigler-IPA) W80-06074

VARIANCE-CONSTRAINED RESERVOIR

A VARIANCE-CONSERVATION OF THE CONTROL PROBLEM, IBM Thomas J. Watson Research Center, Yorktown Heights, NY. For primary bibliographic entry see Field 2H. W80-06145

UMI

4B. Groundwater Management

EVALUATION OF INDUCED INFILTRATION BETWEEN THE RIVER SKERNE AND THE MAGNESIAN LIMESTONE IN SOUTH EAST DURHAM, Plymouth Polytechnic (England). Dept. of Civil

Engineering. L. Hamill.

Journal of the Institute of Water Engineers and Scientists, Vol 34, No 2, p 161-171, March, 1980. 8 Fig, 2 Tab, 8 Ref.

Descriptors: *Induced infiltration, *Aquifers, *Rivers, Ground water mining, Withdrawal,

Droughts, Conjunctive use, Pumping, Water levels, Ground water recharge, Water quality, Water pollution, Surface-ground water relationships, Leakage, Computer models, Water management(Applied).

This paper examines the problem of induced infil-tration resulting from ground water overpumping during droughts. Depending on water quality, in-duced infiltration can be either advantageous by increasing the yield of the well, or potentially disastrous by causing ground water pollution. In either case, if an estimate of the rate of river leakage can be obtained, a model could be con-structed to calculate the maximum withdrawal rate structed to calculate the maximum withdrawal rate that could be tolerated without the associated river leakage exceeding either qualitative or quantitative limits. Such a model was used in a study of induced infiltration between the magnesian limestone duced infiltration between the magnesian limestone aquifer of south east Durham and the River Skerne. Results of this study indicate that the pattern of recharge changed significantly when ground water levels declined below a critical value, the aquifer could be used for water supply during periods of high ground water levels, and the aquifer could be pumped to give a high yield but a low rate of river leakage. Thus it may be possible to develop an aquifer which had previously been thought unsuitable for water supply, manage existing aquifers more efficiently, and use ground and surface water resources conjunctively to obtain optimum yield during droughts without overexploiting either resource. (Purdin-NWWA) W80-06020 W80-06020

STORAGE OF FRESHWATER IN SALINE AOUIFERS.

Harvana Agricultural Univ., Hissar (India). Dept.

of Agricultural Engineering. S. P. Singh, and V. N. M. Vadali

Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 106, No IR 2, p 93-104, June, 1980. 6 Fig, 4 Tab, 17 Ref, 1 Append.

Descriptors: *Aquifer management, *Saline water, *Freshwater, *Storage, Saline water-freshwater in-terfaces, Artificial recharge, Water spreading, Mixing, Diffusion, Skimming, Water wells, Finite difference analysis, Equations, Numerical analysis, Particle size, Water quality, Ground water.

One approach to managing landlocked saline aquifers is to recharge them with freshwater through injection wells or surface spreading. The latter method is more economical to operate. As the freshwater infiltrates from the surface it forms a layer over the saline water and can be pumped at a later stage through 'skimming wells'. However, some mixing of fresh and saline waters will occur due mainly to diffusion. It is assumed that the aquifer is uniform, isotropic and horizontal and there is no lateral movement of water. Experiments were conducted to determine the functional form of the diffusion coefficient. The diffusion coefficient was found to be dependent on concentration and aquifer material. An implicit finite difference solution of the nonlinear diffusion equation was solution of the nonlinear diffusion equation was developed. This numerical solution was used to determine the salinity profiles with respect to time in a freshwater layer stored over a saline layer. The salinity profiles are useful in predicting the water quality of the recharged freshwater layer. (Purelin NUWA) water quality of (Purdin-NWWA) W80_06022

RADIAL PUMP SAVES ON WATER DRAW-

For primary bibliographic entry see Field 8A. W80-06046

MAPS SHOWING GROUND-WATER CONDITIONS IN THE HOPI AREA, COCONINO AND NAVAJO COUNTIES, ARIZONA-1977,

Geological Survey, Tucson, AZ. Water Resources For primary bibliographic entry see Field 7C.

CLASSIFICATION OF GROUND-WATER RE-CHARGE POTENTIAL IN THREE PARTS OF SANTA CRUZ COUNTY, CALIFORNIA, Geological Survey, Menlo Park, CA. Water Re-

sources Div.

sources Div.
K. S. Muir, and M. J. Johnson.
Available from OFSS, Box 25425, Fed. Ctr.
Denver, CO. 80225. Paper copy \$3.50, microfiche
50.50. Geological Survey open-file report 79-1065
(WR(), December 1979. 1 Sheet, 2 Fig, 5 Ref.

Descriptors: *Groundwater recharge, *Evaluation, *California, *Groundwater potential, *Geology, Aquifer characteristics, Natural recharge, Permeability, Groundwater resources, Planning, Water quality, Water pollution control, *Santa Cruz quality, Wat

Ground-water recharge potential was classified in the Santa Cruz coastal area, North-central area, and Soquel-Aptos area in Santa Cruz County, Calif., for three data elements that affect recharge; Calli., for three data elements that affect recharge; slope, soils, and geology. Separate numerical maps for each element were composited into a single numerical map using a classification system that ranked the numbers into areas of good, fair, and poor recharge potential. Most of the Santa Cruz coastal area and the Norht-central area have a poor recharge potential, and much of the Soquel-Aptos area has a good to fair recharge potential. (Kosco-USGS) W80.06056

PLANNING GROUNDWATER SUPPLY SYSTEMS FOR URBAN GROWTH: APPLICATIONS TO WEST LAFAYETTE, INDIANA, Purdue Univ., Lafayette, IN. Water Resources Re-

search Center. G. V. Loganathan, J. W. Delleur, and J. J

G. V. Loganatian, J. W. Berten, and C. Talavage.

Available from the National Technical Information Service, Springfield, VA 22161 as PB80-207491.

Price codes: A05 in paper copy, A01 in microfiche. Technical Report No 131. July 1980. 74 p 13 Fig, 9 Tab, 36 Ref, 2 Append. OWRT B-083-IND(1).

Descriptors: *Well spacing, *Water distribution, *Water supply, Water wells, Groundwater, Drawdown, Aquifer management, Distribution patterns, Urban land use.

In Water supply systems predicting the spatial disaggregation of the demand is one of major concern. In this study a landuse allocation model is used for this purpose. The future zonewise devel-opment of different landuse activities is converted into an equivalent water demand based on the requirements of the activities projected. Other important facets are the determination of optimal locations of water wells and of distribution reservoirs along with the optimal flow values and pipe sizes. The annualized cost of the well field, distribution reservoirs, pipes and pumping is minimized. The indivisibility requirement of the number of wells and reservoirs and the continuous variation of flow values require the use of a Mixed Integer Programming (MIP) approach for the optimization. The nonlinear head losses result in nonlinear objective function and constraints. The nonlinearobjective function and constraints. The nonlinearity is circumvented by making use of empirical formulas and well design criteria. The new are located so that the additional drawdowns do not adversely affect the existing system. A two level coordination scheme is used to optimally distribute coordination series is used to optimizing distribute the facilities and to guarantee a safe exploitation of the aquifer in the future. This task is performed by the program WATSUP, which includes a finite element formulation of the groundwater flow. The methodology is applied to an actual dituation in West Lafayette, Indiana. W80-06158

STORAGE OF FRESHWATER IN SALINE

STORAGE OF FRESHWATER IN SALINE AQUIFERS,
Haryana Agricultural Univ., Hissar (India). Dept. of Agricultural Engineering.
S. P. Singh, and V. V. N. Murty.
Journal of the Irrigation and Drainage Division, American Society of Civil Engineers, Vol 106, No IR2, Proceedings Paper 15476, p 93-104, June 1980. 6 Fig. 4 Tab, 17 Ref, 2 Append.

WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

Identification Of Pollutants-Group 5A

Descriptors: *Aquifers, *Saline water-freshwater interfaces, *Diffusion, *Model studies, Hydraulic models, Laboratory tests, Mathematical models, Mixing, Recharge, Artificial recharge, Groundwater recharge, Groundwater, Storage, Salinity, Salts, Freshwater, Water management(Applied), *Aquifer management, Saline aquifers, Freshwater

Studies were conducted to determine the salinity profiles in a freshwater layer stored over saline water in groundwater aquifers. The one-dimensional diffusion equation was taken as the governing equation, and the diffusion coefficient was assumed to be dependent upon concentration. Using this experimental data, the authors determined the functional form of the diffusion coefficient. An implicit finite difference solution was used to solve implicit finite difference solution was used to solve the nonlinear diffusion equation. The solution has been used to determine the salinity profiles in the freshwater layer. (Sims-ISWS) W80-06199

4C. Effects On Water Of Man's Non-Water Activities

DISSOLVED OXYGEN IN INTRAGRAVEL WATER OF THREE TRIBUTARIES TO RED-WOOD CREEK, HUMBOLDT COUNTY, CALI-

Geological Survey, Helena, MT. Water Resources Div.

Water Resources Bulletin, Vol 16, No 1, p 105-111, February 1980. 4 Fig. 4 Tab, 22 Ref.

Descriptors: *Dissolved oxygen, *Water quality, *Sediment transport, *Particle size, *Tributaries, Streamflow, Watersheds(Basins), Lumbering, Surface waters, *Redwod Creek(CA), *Humboldt County(CA).

As part of a study of Redwood National Park in northwestern California an investigation was con-ducted from June to November 974 on intragravel ducted from June to November 974 on intragravel dissolved oxygen and sediment in three tributaries to Redwood Creek, a major coastal stream that flows through Redwood National Park. Of concern was whether the intragravel environment of streams in logged redwood-forested drainage basins was different. The tributary in the unlogged drainage basin had lower percentages of fine streambed sediment than either of the tributaries in logged drainage basin. Concentration and percentages saturation of dissolved oxygen of intragravel age saturation of dissolved oxygen of intragravel water were highest in the stream in the unlogged water were inglies in the stream in the minoged drainage basin, intermediate in the stream in the patch-cut drainage basin, and lowest in the stream in the clear-cut drainage basin. The differences in intragravel dissolved-oxygen conditions among the intragravel dissolved-oxygen conditions among the three tributaries are attributed chiefly to differ-ences in their interchange of surface and intragra-vel water. The large quantities of fine streambed sediment in the two strems in logged basins may have reduced the permeability of the streambeds and hence their capacity to interchange surface and intragravel water. However, differences in the ilthology of the three tributary drainage basins examined may contribute to the differences in the percentage of fine sediments observed among the streams, even in the absence of logging. (Kosco-USGS) W80-06066

URBANIZATION-INDUCED IMPACTS ON IN-FILTRATION CAPACITY AND ON RAINFALL-RUNOFF RELATION IN AN HAWAIIAN URBAN AREA,

Hawaii Univ., Honolulu. Water Resources Research Center.

search Center.
E. T. Murabayashi, and Yu-Si Fok.
Available from the National Technical Information
Service, Springfield, VA 22161 as PB80-206196,
Price codes: A04 in paper copy, A01 in microfiche.
Technical Report No 127, September 1979, 48 p,
13 Fig. 10 Tab. OWRT-A-050-HI(1), 14-31-00015011, 14-34-0001-6012, 7025, 7026.

Descriptors: *Infiltration, *Rainfall-runoff relationships, *Urbanization, *Storm runoff, Land use, Flood hydrology, Soil moisture, Hawaii, Greenampt equation, ILLUDAS model, Oxisol, St. Louis Heights watershed, Mililani Town, Oahu.

The effect of urbanization on infiltration and rainfall-runoff relations was investigated at Mililani town, Oahu, Hawaii, a residential community. The double-ring method determined the mean constant infiltration rate be 17.58 cm/hr (7.03 in,/hr) under infiltration rate be 17.58 cm/hr (7.03 in/hr) under preurban, long-abandoned, and overgrown pineapple field conditions. Following the transitional grubbing and lot-shaping operations, the rate slowed respectively to 7.45 cm/hr (2.98 in/hr) and 1.28 cm/hr (0.51 in/hr). The rate rose slightly to 2.95 cm/hr (1.18 in/hr). The rate rose slightly to 2.95 cm/hr (1.18 in/hr) under lawn, the new permanent cover. There was no significant difference between recreational and nonrecreational lawns. Incorporated in these results are unmeasurable quantities of lateral flow through the prorus soil under original and grubbed conditions. Based on the data, however, the constant infiltration rate is reduced 33% after urbanization. For single-family the data, however, the constant infiltration rate is reduced 83% after urbanization. For single-family residential areas the impermable area overlaid by paving and buildings was 57% of the total surface area; for town houses it was 64%. Based on the experimental data for single-family residential areas, the combined effect of reduced soil infiltration and accrued impermeable surface area is estimated to reduce infiltration opportunity 10 to 1 after urbanization. Or, there may be as much as 93% reduction in infiltration after urbanizatin, de-neding on whether rainfall frequency, intensity. 93% reduction in infiltration after urbanizatin, de-pending on whether rainfall frequency, intensity, and furation exceed infiltrative capacity, the impact of urbanizatin was evaluated with a digital using the St. Louis Heights Watershed Model (modified ILLUDAS) with field masured rainfall-runoff relations as the basis for verification. When runoff relations as the basis for verification. When pervious lawns surface is substitutted for impervious areas as inputs, the peak runoffs are much less than those simulated with existing impervious lands. The reduction in peak runoff from one selected storm is estimated at 79% of the observed peak. W80-06078

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

TRANSFERENCE MECHANISM OF POLY-CHLORINATED BIPHENYL BY AQUATIC ORGANISMS, Georgia Univ., Athens. Coll. of Experiment Sta-

tion.

M. K. Hamdy.

Available from the National Technical Information Service, Springfield, VA 22161 as PB80-202864, Price codes: A04 in paper copy, A01 in microfiche. Environmental Resources Center, Georgia Institute of Technology, Atlanta, Report No ERC 01-80, January 1980, 51 p. 8 Fig. 8 Tab, 21 Ref, 2 Append. OWRT A-073-GA. 14-34-0001-8011.

Descriptors: *Polychlorinated biphenyls, Uptake, Depuration, Water pollution, Biotransference, Food chain, Aquatic organisms, Sediments.

Thirteen polychlorinated biphenyls (PCBs) resistant cultures were isolated from sediments containing more than 1000 ug PCB/g sediment. These cultures were found to be of the genus Bacillus. The authors were able to induce some mutants The authors were able to induce some mutants from these cultures than can grow in laboratory basal salt medium containing high levels of PCB (2500 ug PCB/ml medium). These mutants were also able to biodegrade the PCBs (1254) compounds. The effectiveness of this biodegradation varied between mutants and ranged from 42-62%. It is concluded that feasibility studies, on an economical bases, should be looked at with emphasis on end product. Both uptake and concentration factor (CF) of 14C-Polychorinated biphenyls were determined in several flood chain systems and were affected by the trophic level, incubation time and by age of cells. Bacterial cells containing 14C-PCB were fractionated into 5 fractions; cold

TCA, alcohol, alcohol-ether, hot TCA, and proteins. Most of the radioactivities were in alcohol (60%) and alcohol-ether fractions (17%) indicating bioaccumulation in cellular lipids. Three day larvae exhibited a 5.14% uptake and 553 CF at 96 hr; 5 day larvae had 2.56% uptake and CF of 209. Guppies showed 3.56% uptake and CF of 197 at 96 hr. It is concluded that all food chain systems examined showed a high level of PCB uptake and concentration factor. W80-06004

INVESTIGATION OF GROUNDWATER QUALITY AND ITS EFFECT ON SUBURBAN DEVELOPMENT IN WASHOE VALLEY,

VELOPMENT IN WASHOE VALLEY, NEVADA,
Nevada Univ. System, Reno. Desert Research Inst.
A. T. Armstrong, and J. W. Forham.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-203326, Price codes: A04 in paper copy, A01 in microfiche. Project Report No 48, 1977. 60 p, 8 Fig., 5 Ref., 3 Append. OWRT A-065-NEV(2). 14-34-0001-6029.

Descriptors: *Groundwater quality, *Community development, Urbanization, Water analysis, Water quality, Chemical analysis, Streamflow, Water wells, Path of pollutants, Nevada, Truckee River

In response to water quality problems in the New Washoe City-Washoe Farms portion of the Washoe Valley, Nevada, an area of more than 200 households, a water quality study was initiated in November 1974 by the Water Resources Center. During the course of the study, 257 water samples were collected for chemical analysis from domestic wells and streams flowing into the valley. In addition, any comparing the 260 well analysis were available. wells and streams flowing into the valley. In addition, approximately 260 well analyses were available from other sources. Also, the rates of flow were measured, on a monthly basis, of inflowing streams for a period of one year. The study has yielded knowledge not previously available. This information is however, subject to revision and refinement as more wells are sampled by other interested parties. The major points are: (1) Surface inflow may be eliminated as the direct source of contamination in the groundwater of the New Washoe City-Washoe Farms area. (2) A more accurate estimate of the volume of surface inflow to Washoe City-Washoe Farms area. (2) A more ac-curate estimate of the volume of surface inflow to the valley than was previously possible has been made. (3) The areal occurrences of fluoride, nitrate and iron, which constitute the major water quality problems is described as well as numerous other constituents of interest and areas of deleterious levels delineated. (Schulke-Nev) W80-06005

EVALUATION OF MUTAGENICITY TESTING OF EXTRACTS FROM PROCESSED OIL SHALE,

Utah Water Research Lab, Logan

J. G. Dickson, and V. D. Adams.

Available from the National Technical Information Available from the National I ecunical Information Service, Springfield, VA 2161 as PB80-203458, Price codes: A04 in paper copy, A01 in microfiche. Report No UWRL/Q-80/01, Water Quality Series, May 1980. 49 p. 20 Fig. 13 Tab, 135 Ref. OWRT B-154-UTAH(1). 14-34-0001-8123.

Descriptors: *Oil shales, *Pollutant identification, *Toxicity, *Bioassay, Laboratory tests, Bioindicators, Testing procedures, Salmonella, Water pollution, Chemical analysis, Organic compounds, Water pollution effects, Cytological studies, Evaluation, Mutagenesis, Ames test.

The evaluation of the carcinogenic potential of processed oil shale extracts was carried out by the use of the Ames/Salmonella mutagenicity assay. Four types of spent oil shale were used to obtain samples for testing and the polycyclic aromatic hydrocarbons (PAH) contained in the shale extracts are known to give about 90% detection rate by the Ames test. Soxhlet extraction of the shale with organic solvents gave extracts which were found to contain mutagenically-active fractions. The choice of solvents was shown to have a great effect on the magnitude of the mutagenic response and may also generate a co-mutagenic effect. The Ames test failed to identify mutagens in the aque-

Field 5-WATER QUALITY MANAGEMENT AND PROTECTION

Group 5A—Identification Of Pollutants

ous leachates from the spent oil shale. One of the major problems of the Ames test was that the dose response curves of one-to-one mixture of two mutagens were nonsaddiw. Benzo (a) pyrene, a strong mutagenic PAH, was found to mask the mutagenic response of other mutagens. The complex mixture of PAHs in processed oil shale may exhibit high mutagenicity due to possible co-mutagenesis. Further biological testing is necessary to establish the environmental impact of natural leaching of oil shale waste and the reliability of the Ames test. (Sidney-IPA) Ames test. (Sidney-IPA) W80-06009

ACUTE TOXICITY TO GOLDFISH OF MIXTURES OF CHLORAMINES, COPPER, AND LINEAR ALKYLATE SULFONATE, Maryland Univ., Solomons. Chesapeake Biological

Lab

Lab.
C.-F. Tsai, and J. A. McKee.
Transactions of the American Fisheries Society,
Vol 109, p 132-141, 1980. 7 Fig. 3 Tab, 28 Ref.
OWRT-A-029-MD(2), 14-34-0001-7044.

Descriptors: *Bioassay, *Toxicity, *Copper, *Linear alkylate sulfonates, Chemical properties, Detergents, Sewage effluents, Waste treatment, Chlorination, Ammonia, *Chloramines, *Goldfish,

The toxicity to goldfish (Carassius auratus) of mix-tures of chloramines, copper, and linear alkylate sulfonate (LAS) was studied by continuous-flow toxicity tests during an exposure period of 96 hours. The individual toxicities of these three nours. The individual toxicities of trese three chemicals are either additive or synergistic in mixtures, depending on the rate of toxic action of the individual chemical, the toxicity ratio of the chemicals in the mixtures, and the concentration of the mixtures. (Deal-EIS) W85-06042

OCCURRENCE OF SALT AND LEAD IN SNOW DUMP SITES,
Ontario Hydrology, Toronto. Dept. of Transmis-

sion Environment

W. S. Scott. Water, Air, and Soil Follution, Vol 13, No 2, p 187-195, June 1980. 5 Fig, 4 Tab, 7 Ref.

Descriptors: *Snow, *Salts, *Lead, *Deicers, Roads, sodium, Chlorides, Pollutant identification, Water pollution, Melt water, Runoff, Soils, Soil contamination, Sampling, Chemical analysis, path of pollutants, *Toronto(Ontario), Snow dumps.

Sodium, Cl, and Pb contents of snow, meltwater, and soil from ten Metropolitan toronto snow dumps were determined. Contaminant concentrations were related to the source of the snow. Although initially very high, Na and Cl concentrations in the snow decreased with time while piled at the dump site. Conversely, Pb content increased with time as the snow gradually melted and the Pb-containing particulates accumulated on the snow surface. The Na and Cl content of the meltwater was related to the concentrations in the snow, but the mean levels decreased with time. snow, but the mean levels decreased with time, indicating that parts of the piles with higher salt concentrations were melting and draining away before the remaining areas. Although some Na and Cl is leached from the soil during the summer months, much of the sait and most of the Pb remains to accumulate from year to year. Adjacent to the snow piles, the soil contained contaminant concentrations that were higher than control samples, possibly as a result of the movement of meltwater runoff. (Sims-ISWS)
W80-06085

DETERMINATION OF CERIUM IN MARINE Bhabha Atomic Research Centre, Bombay (India).

JMI

M. D. Borkar. Water, Air, and Soil Pollution, Vol 13, No 2, p 133-141, June 1980. 3 Fig, 3 Tab, 17 Ref.

Descriptors: *Sediments, *Oceans, *Radioisotopes, Sampling, Chemical analysis, Colorimetry, Pollutants, Isotope studies, Pollutant identification, Mon-

itoring, Coasts, Tidal water, *Cerium, *India, Marine sediments.

Marine sediments carry almost all the radioactive Ce that enters the ocean with the effluents released from the nuclear industry. The uptake of radioac-tive 144Ce by the sedentary organisms is influ-enced by the amount of stable Ce present in the sediment. A method was described for the determi-nation of stable Ce in the sediments based onion exchange separatin and colorimetric measurement with Arsenazo I reagent. The effect of diverse cations on the recovery of Ce was discussed. Lanthanum, Y, Th, and Zr, which form colored complexes with Arsenazo I, did not interfere under complexes with Arbeitazo I, and not met reter under the conditions of the experiment. The recovery of stable Ce ranged from 95-98%. Using the method, the stable Ce content in some sediments from coastal Bombay were observed to range from 20-99 ppm. The same method with minor changes was described for the determination of radioactive Ce in the sediments and illustrated with the analysis of a sediment sample. (Sims-ISWS) W80-06086

ANALYSIS OF NON-POINT POLLUTION EXPORT FROM SMALL CATCHMENTS, North Dakota State Univ., Fargo. Dept. of Civil Engineering. For primary bibliographic entry see Field 5B. W80-06090

POTENTIAL FOR CHANGING PHYTO-PLANKTON GROWTH IN LAKE POWELL DUE TO OIL SHALE DEVELOPMENT, Utah Water Research Lab., Logan. For primary bibliographic entry see Field 5B. W80-06092

ORGANIC-RICH COLLOIDAL MARERIAL IN ESTUARIES AND ITS ALTERATION BY CHLORINATION,

Maryland Univ., College park. Dept. of Chemis-

A. C. Sigleo, G. R. Helz, and W. H. Zoller. Environmental Science and Technology, Vol 14, No 6, p 673-679, June 1980. 4 Fig, 5 Tab, 34 Ref.

Descriptors: *Colloids, *Estuaries, *Chlorination, *Trace elements, Halogens, Metals, Carbon dioxide, Water chemistry, Sampling, Chemical analysis, Pollutants, Water pollution, Organic matter, Data processing, Analytical techniques, Chemistry.

Major and trace element analyses for over 30 ele-ments indicated that chlorination increases the conments indicated that chloramon increases the con-centration of halogens, Mn, and certain other trace elements in the colloidal organic material in estur-arine waters. The primary halogen substituent in freshwater is chlorine, whereas in brackish waters the oxidation of Br(-) to HOBr by chlorine pro-duces a dramatic bromine enrichment in chlorinat-ed samples. In experiments designed to measure CO2 production, yields of about 1/3 mol of CO2 per mol of initial chlorine were found after storage of acidified, chlorinated smaples for 1 week. This suggests that oxidatin of organic matter, ultimarely suggests that oxidatin of organic matter, ultimarely to CO2, is quantitatively far more important than halogen substitution, or metal oxidation, in the consumption of chlorine.)Sims-ISWS) W80-06093

THE DISTRIBUTION OF MERCURY, CESIUM-137, AND PLUTONIUM IN AN INTERMITTENT STREAM AT LOS ALAMOS, Los Alamos Scientific Lab., NM. Environmental Science Group. For primary bibliographic entry see Field 5B.

W80-06106

NUTRIENTS AND ASSOCIATED ION CON-CENTRATIONS IN IRRIGATION RETURN FLOW FROM FLOODED RICE FIELDS,

Texas Agricultural Experiment Station, Beaumont. For primary bibliographic entry see Field 5B. W80-06108

NUTRIENT AND COLIFORM LOSSES INRUN-OFF FROM FERTILIZED AND SEWAGE SLUDGE-TREATED SOIL, Louisiana State Univ., Baton Rouge. Dept. of

For primary bibliographic entry see Field 5B. W80-06109

SORPTION OF DIBENZOTHIOPHENE BY SOILS AND SEDIMENTS,
Illinois Univ. at Urbana-Champaign. Dept. of

For primary bibliographic entry see Field 5B. W80-06110

ENVIRONMENTAL CONTAMINATION THROUGH RESIDUAL TRACE METAL DIS-PERSAL FROM A DERELICT LEAD-ZINC MINE.

Liverpool Univ. (England). Dept. of Botany. For primary bibliographic entry see Field 5B. W80-06111

OXIDATIVE POLYMERIZATION OF DIS-SOLVED PHENOLS BY SOLUBLE AND IN-

SOLVED PHENOLS BY SOLUBLE AND IN-SOLUBLE INORGANIC SPECIES, Academy of Natural Sciences of Philadelphia, Avondale, PA. Stroud Water Research Center. R. A. Larson, and J. M. Hufnal, Jr. Limnology and Oceanography, Vol 25, No 3, p 505-512, May 1980. 2 Fig, 5 Tab, 35 Ref. NSF BMS-77-23389.

Descriptors: *Organic matter, *Streams, *Water chemistry, *Water properties, Oxidation, Polymers, Water quality, Water sampling, Sampling, Sediments, Analytical techniques, Analysis, Methodology, Laboratory tests, Hydrogen ion concentration, Phenols, Manganese, Iron, Zinc, Copper, Cations, Oxides, Metals, Dissolved organic matter, Polymerization, Catechol

Transition metal oxides (MnO2, ZnO, CuO) and cations (Mn(2+), Fe(3+)) promoted the polymerization of dissolved catechol (1,2-dihydroxybenzene) and other catechol and pyrogallol derivatives. The manganese species were the most efficient. Colored polymers were formed from catechol much more rapidly in stream waters than in deionized water buffered to the same pH. Addition of sediments or clays increased polymerization; addition of EDTA or lowering the pH reduced it. Ultrafiltration or autoclaving of the stream water samples had no significant effect. The mechanism appears to incorporate an activation of dissolved O2 to a more reactive species, probably OH. (Humphreys-ISWS)

CHARACTERIZATION OF ORGANIC NITROGEN IN NATURAL WATERS: ITS MOLECULAR SIZE, PROTEIN CONTENT, AND INTERACTIONS WITH HEAVY METALS,

Florid Univ., Gainesville. Dept. of Environmental Engineering Sciences. For primary bibliographic entry see Field 2H. W80-06114

DISTRIBUTION OF OXYGEN IN MARINE SEDIMENTS MEASURED WITH MICROELECTRODES,

Aarhus Univ. (Denmark). Inst. of Ecology and For primary bibliographic entry see Field 2L. W80-06117

FRACTIONATION OF SEDIMENT OXYGEN DEMAND, Illinois State Water Survey, Peoria.

W. Wang. Water Research, Vol 14, No 6, p 603-612, 1980. 8 Fig, 3 Tab, 19 Ref.

Descriptors: *Sediments, *Lake sediments, *Oxygen demand, Biochemical oxygen demand, Chemical oxygen demand, Phenols, Iron, Manganese, Sulfides, Oxygen, Lakes, Water pollution,

WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

Sources Of Pollution—Group 5B

Pollutants, Sampling, Laboratory tests, Water pollution control, Toxins, Chemicals, Distillation.

Several biological inhibitors were tested for sepa-Several biological unhibitors were tested for separation of biological and chemical sediment oxygen demand (SOD) of lake sediments. Phenol was selected. Chemical SOD was further separated by ferrous, sulfide, and manganous demand. The results showed that the major component of SOD is chemical in contrast to biological and that the demand due to iron predominates. (Sims-ISWS)

RELATIONSHIPS BETWEEN HETEROTRO-PHIC BACTERIA AND POLLUTION IN AN INDUSTRIALIZED ESTUARY, Hull Univ. (England). Dept. of Plant Biology. For primary bibliographic entry see Field 5B.

W80-06126

ANALYSIS OF ORGANIC CARBON IN MARINE SEDIMENTS,
Rhode Island Univ., Kingston. Graduate School of

Oceanography

P. N. Froelich. Limnology and Oceanography, Vol 25, No 3, p 564-572, May 1980. 5 Fig, 6 Tab, 19 Ref. NSF DES-76-02318.

Descriptors: *Pollutant identification, *Organic matter, *Carbon, Laboratory tests, Methodology, Data collections, Analytical techniques, Analysis, Calcium carbonate, Water chemistry, Testing procedures, *Marine sediments, Organic carbon

A method was presented for measuring organic carbon in both carbonate-rich and carbonate-poor marine sediments. Samples were sonicated with phosphoric acid to remove carbonates. The spent acid supernatant was analyzed for dissolved organ-ic carbon, the solid residue for total carbon; their sum yields the organic carbon content of the sample. The technique is free from carbonate interferences, involves no losses due to acid solubiliza-tion, and has excellent precision (better than + or -0.02% C sub org) and accuracy (better than + or -2%). (Humphreys-ISWS) W80-06133

THE EFFECTS OF TRANSECT DIRECTION ON OBSERVED SPATIAL PATTERNS OF CHLOROPHYLL IN LAKE TAHOE,

California Univ., Davis, Div. of Environmental

For primary bibliographic entry see Field 2H. W80-06135

TRACE METAL BUDGETS FOR A FORESTED WATERSHED IN THE NEW JERSEY PINE

BARRENS, Pennsylvania Univ., PA. Dept. of Geology. K. A. Swanson, and A. H. Johnson Water Resources Research, Vol 16, No 2, p 373-376, April 1980. 5 Tab, 19 Ref.

Descriptors: *Trace elements, *Metals, *Forest watersheds, *Sampling, *New Jersey, Precipitation(Atmospheric), Streamflow, Groundwater, Lead, Copper, Nickel, Iron, Manganese, Cadmium, Pollutants, Water pollution, Pollutant identification, Path of pollutants, Trace metal budgets

Deposition of Pb, Cu, Ni, Fe, Mn, and Cd on the McDonalds Branch Basin in bulk precipitation was 25.4, 5.3, 6.6, 64.6, 20.7, and less than 2 mg/sq m/yr for a 1 year period in 1978-1979. Output in streamflow was 1.7, 0.7, 1.9, 148, 12.8, and less than 1 mg/sq m/yr, respectively, and loss to deep groundwater was 1.4, 1.9, 2.3, 123, 20.4, and less than 1 mg/sq m/yr. Pb, Cu, and Ni accumulated in the basin, while there was a net loss of Fe and Mn from the ecosystem. The major mechanism for movement of Fe and Pb out of the basin was interpreted to be complexation with and transport interpreted to be complexation with and transport by mobile organic matter. (Sims-ISWS) by mobile o W80-06144

THE INCIDENCE OF WATER QUALITY: A COUNTY LEVEL ANALYSIS, Rutgers - The State Univ., New Brunswick, NJ. Dept. of Economics.

P. Asch, and J. J. Seneca. Water Resources Research, Vol 16, No 2, p 319-324, April 1980. 7 Tab, 14 Ref.

Descriptors: *Water quality, *Domestic water, *Income distribution, *Pollutants, Dissolved oxygen, Coliforms, Phenols, Arsenic compounds, Cadmium, Hardness@water), Radiation, Correlation analysis, Potable water, Water supply, Barium.

Relationships between nine quality characteristics of domestic water systems and the income and racial composition of the using populations were examined for a national sample of counties. Simple correlations suggested a regressive distribution for some but not all pollutants. More detailed analysis of two pollutants adjusted for variation in size of county population and showed a regressive distribution of fecal coliform but an income neutral distribution of fecal coliform but an income neutral distribution of fecal coliform but the type of analysis required to draw broader incidence conclusions. (Sims-ISWS) (Sims-ISWS) W80-06150

5B. Sources Of Pollution

INVESTIGATION OF GROUNDWATER QUAL-ITY AND ITS EFFECT ON SUBURBAN DE-VELOPMENT IN WASHOE VALLEY, NEVADA

Nevada, Nevada Univ. System, Reno. Desert Research Inst. For primary bibliographic entry see Field 5A. W80-06005

A MODEL TO ASSESS MIGRATION FROM SHALLOW LAND BURIAL FACILITIES, Dames and Moore, Los Angeles, CA. For primary bibliographic entry see Field 7C. W80-06019

GROUND WATER POLLUTION BY SEPTIC TANK DRAIN FIELDS, Washington Univ., Seattle. Dept. of Environmental Health.

For primary bibliographic entry see Field 5G. W80-06023

MOVEMENT OF HEAVY METALS INTO A SHALLOW AQUIFER BY LEAKAGE FROM SEWAGE OXIDATION PONDS,

Volcani Inst. of Agricultural Research, Bet-Dagan (Israel). Inst. of Soil and Water. A. Wolfberg, Y. Kahanovich, M. Avron, and A. Nissenbaum. Water Research, Vol 14, No 6, p 675-679, June,

1980. 2 Fig. 2 Tab, 6 Ref.

Descriptors: *Path of pollutants, *Heavy metals, *Perched water, *Sewage lagoons, Sludge, Soil chemistry, Attenuation, Water pollution, Ground water, Nickel, Manganese, Copper, Cadmium, Chromium, Water reuse, *Israel.

Movement of Cu, Mn, Ni, Cr, and Cd from oxida-Movement of Cu, Mn, Ni, Cr, and Cd from oxida-tion ponds to a shallow perched aquifer underlying the Dan Region Sewage Reclamation Project (Israel) is described. Movement depends on remov-al of metals into the sludge at the bottom of the ponds, rate of leakage, and the specific type and degree of interactions with the soils for each metal. The contribution of effluents to ground water was evaluated on the basis of chloride concentration. Ground water containing more than 60 percent effluents showed a hundred-fold decrease in Cu and Mn at a distance of 650 m from the ponds. Ni effluents showed a hundred-fold decrease in Cu and Mn at a distance of 650 m from the ponds. Ni and Cd showed relatively little removal while Cr showed irregular distribution with distance. The concentrations of Cu and particularly of Mn in the ground water near the oxidation ponds was equal or greater than in the ponds themselves. This suggests that Cu and Mn are mobilized from the sludge into the interstical waters, percolate into the ground water near the ponds and are then precipitated by increasing aeration during the movement of water away from the pond. Cd and Ni form stable soluble organic chelates which are only slightly removed by interaction with the sandy soil of the aquifer. (Purdin-NWWA) W80-06026

WATER-QUALITY DATA FOR CANALS IN EASTERN BROWARD COUNTY, FLORIDA,

Geological Survey, Tallahassee, FL. Water Re-For primary bibliographic entry see Field 7C. W80-06061

OCCURRENCE OF SALT AND LEAD IN SNOW DUMP SITES, Ontario Hydrology, Toronto. Dept. of Transmission Paris and Paris an sion Environment For primary bibliographic entry see Field 5A. W80-06085

ANALYSIS OF NON-POINT POLLUTION EXPORT FROM SMALL CATCHMENTS, North Dakota State Univ., Fargo. Dept. of Civil

Rothin Dakota State Cinv., Pargo. Dept. of Civil Engineering. D. M. Griffin, Jr., T. J. Grizzard, C. W. Randall, D. R. Helsel, and J. P. Hartigan. Journal of the Water Pollution Control Federation, Vol 52, No 4, p 780-790, April 1980. 17 Fig. 10 Tab, 13 Ref.

Descriptors: "Water pollution sources, "Urban runoff, "Storm runoff, Sampling, On-site investigations, Pollutants, Suspended solids, Biochemical oxygen demand, Nitrogen, Phosphorus, Coliforms, Precipitation(Atmospheric), Rainfal, Data processing, Analytical techniques, "Non-point water pollution sources."

Water pollution abatement programs in the U.S. have long been founded on a philosophy of point source control. This approach may have been a reflection of the repective comprehension levels of the impacts of point and nonpoint source pollution on receiving water quality. The pollutant loads contained in point source discharges are relatively simple to quantify because the point of entry into the watercourse is fixed, and the flow rates are generally known. Stormwater pollution loads, by contrast, generally have no fixed point of origin. contrast, generally have no fixed point of origin, and the flow rates are not as well documented. In recent years, more studies have been conducted at the level of detail necessary to adequately assess pollution generation by stormwater runoff. One pollution generation by stormwater runoft. One factor affecting the magnitude of the runoff problem is certainly the land use within the runoff generating basin. Identifying those land use characteristic that most strongly affect the quality and quantity of runoff thus become essential implanning the development of a watershed. Knowledge of physical-chemical properties of pollutant transport then becomes imprograte in devicing management. physical-chemical properties of poliutant transport then becomes important in devising management strategies. An additional concern in trying to estab-lish the land use characteristis of greatest impor-tance is the nature of the data collected and, there-fore, the appropriate method of analysis. The final objectives of the research reported in this paper were to establish the importance of some land use were to establish the importance of some land use characteristics on nonpoint pollutant yields and to provide insight into mechanisms affecting the 'first flush' phenomenon frequently reported by re-searchers. A basic purpose of this paper, however, was to present a rational approach for the analysis of stormwater runoff data. (Sims-ISWS) W80-06090

POTENTIAL FOR CHANGING PHYTO-PLANKTON GROWTH IN LAKE POWELL DUE TO OIL SHALE DEVELOPMENT,

Utah Water Research Lab., Logan.
M. L. Cleave, D. B. Porcella, and V. D. Adams.
Environmental Science and Technology, Vol 14,
No 6, p 683-690, Jun 1980. 6 Fig. 4 Tab. 29 Ref.

Descriptors: *Oil shales, *Phytoplankton, *Water pollution sources, *Laboratory tests, Leachate, Leaching, Lakes, Pollutants, Chemicals, Salts, Chemical analysis, Bioassay, Algae, Growth rates, Water pollution, Mining, *Lake Powell(UT).

Field 5-WATER QUALITY MANAGEMENT AND PROTECTION

Group 5B-Sources Of Pollution

The potential effects of oil shale leachate and salinity additions on the productivity of freshwater algae were studied in laboratory studies using batch bioassays. These batch bioassays were used to screen variations of water extractions of differto screen variations of water extractions of different processed and unprocessed oil shales, and the concentration effects of both the slats and the sale extractions on the growth of indigenous algae fromlake Powell. The batch bottle bioassays were conducted following the standard algal assay procedure as closely as possible. Variations in the standard algal assay procedure included mdis variations with the procedure as closely as possible. ation with the use of an indigenous algal genus isolated from Lake Powell. The growth of the indigenous algal genus (Scenedesmus) was stimu-lated by adding oil shale extract at lower concen-trations. Higher concentrations of oil shale leachate inhibited the indigenous algal growth. (Sims-W80-06092

ORGANIC-RICH COLLOIDAL MARERIAL IN ESTUARIES AND ITS ALTERATION BY CHLORINATION, Maryland Univ., College park. Dept. of Chemis-

For primary bibliographic entry see Field 5A.

EFFECTS OF CHEMICAL DEFOLIATION OF AN ABIES GRANDIS HABITAT ON AMOUNTS AND CHEMISTRY OF THROUGHFALL AND

Pacific Northwest Forest and Range Experiment Station, Wenatchee, WA. For primary bibliographic entry see Field 2B. W80-06105

THE DISTRIBUTION OF MERCURY, CESIUM-137, AND PLUTONIUM IN AN INTERMITTENT STREAM AT LOS ALAMOS, LOS ALIAMOS, Los Alamos Scientific Lab., NM. Environmental

Science Group. T. E. Hakonson, G. C. White, E. S. Gladney, and

JMI

Journal of Environmental Quality, Vol 9, No 2, p 289-292, April-June 1980. 2 Fig, 3 Tab, 10 Ref. DOE W-7405-ENG-36.

Descriptors: *Radioisotopes, *Pollutants, *Waste disposal, "Intermittent streams, Streams, Sediments, Effluents, Sampling, Monitoring, Distribution patterns, Spatial distribution, Path of pollutants, Water pollution, "Mercury, "Cesium, Variants, Water pollution," ability, *Plutonium.

This paper summarized the results of a study on the distribution of Hg, 137Cs, 238Pu, and 239,240Pu in channel sediments and adjacent bank soils in an intermittent stream used for treated liquid effluent disposal since 1963. Concentrations of the three radionuclides and Hg in stream bank soils were comparable to adjacent channel sediments demonstrating that the stream bank serves as a deposition site for chemicals released to the channel. This finding has important implications on the long-term behavior of effluent contaminants since other studies at Los Alamos have shown that the vegetated stream banks retard downstream movement of chemicals bound to soils and provide a pathway for transport of these materials to biota Concentrations of the radionuclides and mercury were more uniformly distributed with distance and depth in the channel sediments than in the bank soils. The action of priodic surface water in the channel partially explains those differences. Statistical analysis of the data revealed that 50-85% of the variability in contaminant concentrations in bank and channel locations was due to variation with distance, whereas depth contributed relative-ly little to variability. (Sims-ISWS) W80-06106

NUTRIENTS AND ASSOCIATED ION CON-CENTRATIONS IN IRRIGATION RETURN FLOW FROM FLOODED RICE FIELDS, Texas Agricultural Experiment Station, Beaumont. F. T. Turner, K. W. Brown, and L. E. Deuel. Journal of Environmental Quality, Vol 9, No 2, p 256-260, April-June 1980. 2 Fig, 2 Tab, 13 Ref. EPA S802008.

Descriptors: *Water quality, *Rice, Runoff, *Irrigation, *Return flow, Flood irrigation, Nutrients, lons, Nitrates, Nitrites, Ammonia, Hydrogen ion concentration, Feritlizers, Water pollution, Sampling, Monitoring, Data processing, Agriculture, Rice culture, Irrigation return flow.

A 3-year field study of nutrient and common ion concentrations in irrigation return flow (IRF) from flooded rice fields utilized replicated plots that received either recommended or excessive fertiliz-er rates with continuous flow or intermittent flood er rates with continuous flow or intermittent flood irrigation. All P and K and 40% of the (NH4)2SO4 introgen (N) were applied preplant and incorporated. The remaining N was applied just prior to permanently flooding (40%) and at 7-mm panicle stage (20%). The irrigation and plot waters were analyzed for NH4(+)-N, NO3(+)-N, NO2(+)-N, PO4(3-)-P, K(+), Ca(2+), Mg(2+), Na(+), Cl(-), and SO4(2-). Highest nitrate-N concentrations occurred early in the season before the permanent flood period but did not exceed drinking water standards. Nitrite-N concentrations in the IRF were low at all times. Maximum NH4(+)-N concentrations occurred following N fertilizer applications which were not incorporated into the soil and centrations occurred following N fertilizer applica-tions which were not incorporated into the soil and persisted in the floodwater for 5 to 7 days. These peak NH4(+)-N concentrations exceeded accept-able drinking water standards concentration by a factor of 10 or greater. Concentrations of PO4(3-)-P and K(+) in the floodwater were similar to those in the surface water used for irrigation. The those in the surface water used for irrigation. I he concentration of the other common ions in the floodwater did not greatly exceed those in the irrigation water, and all were within concentrations acceptable for drinking water. Method of fertilizer application had more influence on IRF nutrient concentrations than did fertilizer rates or increasing exceptions. Under the coefficients of the concentration of the control of nutrient concentrations than did fertilizer rates or irrigation management practices. Under the conditions of this study, it appears that only the ammonium concentrations may have a detrimental impact on the quality of IRF from flooded rice fields. This potential problem could be minimized by preventing IRF for a period of 1 week following surface applications of (NH4)2SO4 fertilizer. (Sims-ISWS) W80-06108

NUTRIENT AND COLIFORM LOSSES INRUN OFF FROM FERTILIZED AND SEWAGE SLUDGE-TREATED SOIL,
Louisiana State Univ., Baton Rouge. Dept. of

Agronomy.
E. P. Dick.
Journal of Environmental Quality, Vol 9, No 2, p 243-250, April-June 1980. 5 Fig. 4 Tab, 30 Ref.

Descriptors: *Runoff, *Fertilizers, *Sewage sludge, Nutrients, Nitrogen, Nitrogen compounds, Phosphorus, Potassium, Priospiorus, Precipitation(Atmospheric), Rainfall, Bacteria, Coliforms, Sampling, Monitoring, Chemicals, Chemical analysis, Pollutants, Path of pollutants, Water pollution, "Nutrient losses.

Surface runoff losses of fertilizer elements from forage plots on Loring silt loam soil (5% slope) were monitored from three separate studies during an 11-month period. Incorporating approximately equal amounts of N and P from commercial fertilizer (150-66, kg N-P/ha) and sewage sludge (177-54, kg N-P/ha) did not significantly affect differences in N and P losses. Surface application of sewage sludge resulted in higher N and P losses than those from incorporated sewage sludge. The stwage studge resulted in injurity and P 105cs than those from incorporated sewage sludge. The surface-applied sludge plots in the second experiment (14.8 metric tons/ha) had the highest N and P runoff losses of 3.24 and 0.39 kg/ha, respectively. These losses were due to a heavy rain that fell early in the test period. Increasing the rates of surface-applied sewage sludge from 16.2 to 28.9 metric tons/ha did not increase runoff losses of N but did increase P losses by 285. The N and P losses for all treatments were less than 1% of that added. The highest K losses (1.24 kg K/ha) came from the fertilized plots. In all sewage-treated plots, K losses were approximately equal to or lower than the control values. Precipitation was found to contain substantial quantities of NH4-N and NO3-N with respect to losses of these ions in

the surface water. Work with 15NH4-N indicated that the 15NH4-N in the rain could contribute substantially to the total amount of N 10st in the surface runoff water. There was also exchange of rain-NH4 and soil-NH4. Fecal coliform indicator bacteria (FC) counts in surface runoff waters from sewage-treated plots were very high in the first 11 to 17 days of the second and third experiments; counts of FC were as high as 55,000/ml. However, number decreased rapidly as the soil became drier. (Sims-ISWS) (Sims-ISWS) W80-06109

SORPTION OF DIBENZOTHIOPHENE BY SOILS AND SEDIMENTS, Illinois Univ. at Urbana-Champaign. Dept. of

Agronomy.

J. J. Hassett, J. C. Means, W. L. Banwart, S. G. Wood, and S. Ali.
Journal of Environmental Quality, Vol 9, No 2, p 184-186, April-June 1980. 1 Fig. 2 Tab, 21 Ref. EPA 68-03-2555.

Descriptors: *Sorption, *Aromatic compounds, *Soils, *Sediments, *Model studies, Mathematical models, Organic compounds, Pollutants, Water pollution, Path of pollutants, Coal mine wastes, Sampling, Chemical analysis, Water pollution sources, Polynuclear, Heterocyclic, Hydrophobic sorption, Octanol-water partition coefficient.

The effect of sediment and soil properties on ad-sorption of dibenzothiophene, a potential carcino-genic and/or mutagenic compound, was examined. Sorption isotherms were determined on soil and sediments collected from the Ohio, Missouri, Mississippi, and Illinois rivers and their watersheds. The sorption isotherms were approximately linear and sorption isotherms were approximately linear over the entire concentration range studied. The linear adsorption or partition coefficient was significantly correlated with the organic carbon contents of the soils and sediments. The other factors tested (e.g., total clay, clay mineralogy, CEC, surface area, pH) were nonsignificant. The Koc value estimated from the octanol-water partition coefficient (Keuly users is condecessers with the Mocient (Kow) was in good agreement with the Koc value of 11,230 determined experimentally. The sorption of dibenzothiophene as a result of a week solute-solvent interaction rather than a strong sor-bate-sorbent interaction was discussed. (Sims-ISWS) W80-06110

ENVIRONMENTAL CONTAMINATION THROUGH RESIDUAL TRACE METAL DISPERSAL FROM A DERELICT LEAD-ZINC

MINE, Liverpool Univ. (England). Dept. of Botany. M. S. Johnson, and J. W. Eaton. Journal of Environmental Quality,Vol 9, No 2, p 175-179, April-June 1980. 5 Tab, 18 Ref.

Descriptors: *Mine drainage, *Mine wastes, *Heavy metals, *Water pollution sources, Sampling, Laboratory tests, Chemical analysis, Lead, Zinc, Cadmium, Erosion, Sheet erosion, Gully erosion, Suspended solids, Pyrite, Metals, Water pollution, Water pollution effects, Agriculture, *Wales, Lead-zinc mines.

Studies of historical and current environmental problems in the vicinity of a derelict Pb-Zn mine at Parc, near Llanwrst in North Wales, have shown Parc, near Llamwrst in North Wales, have shown that heavy metal dispersal occurs through contaminated mine drainage waters and episodal erosion of an unstable tailings dam. Since the discontinuation of mining operations, an estimated 13,000 metric tons of metalliferous spoil, equivalent to 43 metric tons Pb, 104 metric tons Zn, and 1 metric ton Cd, have been eroded from the main tailings dam. nave been eroded from the main tailings dam. Dispersal by a tributary of the River Conwy and redeposition during flooding events has caused extensive contamination of lowland agricultural pastures. Streamwater pollution by tailings and dissolved metal salts in mine effluent continues to have a pronounced adverse effect on the flora and fauna of the tributary. Under normal discharge conditions mean net transfer of metals into the main Conwy River approximates to 0.27 kg Pb, 15 kg Zn, and 0.1 kg Cd over 24 hours. However, because of the increases particulate load during

WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

Effects Of Pollution—Group 5C

surface drainage and flooding episodes, net dispersal increases unequally for the different metals, to a rate above that anticipated from discharge-concentration relationships. With a remaining deposit of 250,000 metric tons of mine tailings, tip stabilization measures have been initiated as a safeguard against further degradation of natural resources in the locality. (Sims-ISWS)

THE ANNUAL CYCLE OF PLANKTON DIATOM GROWTH AND SILICA PRODUCTION IN THE INNER OSLOFJORD,

Oslo Univ. (Norway). Dept. of Marine Biology and Limnology. For primary bibliographic entry see Field 2L. W80-06115

STRATIFICATION OF AEROBIC METHANE-OXIDIZING ORGANISMS IN LAKE MEN-DOTA, MADISON, WISCONSIN, Wisconsin Univ.-Madison. Dept. of Bacteriology. For primary bibliographic entry see Field 2H. W80-06116

FRACTIONATION OF SEDIMENT OXYGEN

DEMAND, Illinois State Water Survey, Peoria. For primary bibliographic entry see Field 5A. W80-06125

RELATIONSHIPS BETWEEN HETEROTRO-PHIC BACTERIA AND POLLUTION IN AN INDUSTRIALIZED ESTUARY, Hull Univ. (England). Dept. of Plant Biology. R. Goulder, A. S. Blanchard, P. L. Sanderson, and B. Wright. Water Research, Vol 14, No 6, p 591-601, 1980. 1 Fig, 8 Tab, 34 Ref.

Descriptors: *Water pollution, *Bacteria, *Estuaries, Heavy metals, Sewage, Metals, Copper, Lead, Zinc, Suspended solids, Organic matter, Toxins, Sampling, Data processing, Correlation analysis, Pollutants, Path of pollutants, *Humber estuary(England), *England.

Numbers and activities of heterotrophic bacteria and environmental variables related to pollution were measured in water samples from the Humber were measured in water samples from the Humber estuary. In general, bacterial numbers and activities were positively correlated with organic pollution, and there was no evidence of widespread inhibition of self-purification by toxic pollution. At one site, however, which was adjacent to a discharge of metal refinery effluent, correlations between bacteria and indicators of organic pollution tended to disappear, high levels of Cu, Pb, and Zn were recorded, and bacterial activities were negatively correlated with heavy metals. These observations suggest that toxic pollution caused local inhibition of bacteria. (Sims-ISWS)

FLUORESCENCE: ABSORBANCE RATIOS--A MOLECULAR-WEIGHT TRACER OF DIS-SOLVED ORGANIC MATTER,

Michigan State Univ., Hickory Corners. W. K. Kellogg Biological Station.
A. J. Stewart, and R. G. Wetzel.
Limnology and Oceanography, Vol 25, No 3, p
559-564, May 1980. 5 Fig. 1 Tab, 21 Ref. DOE
EY-76-S-02-1599, COO-1599-150, NSF BMS-75-

Descriptors: *Pollutant identification, *Organic matter, *Fluorescence, *Analytical techniques, Laboratory tests, Lakes, Methodology, Analysis, Chromatography, Measurement, Hydrogen ion concentration, Leachate, Testing procedures, Chemical analysis, Water chemistry, *Lawrence Lake(MI), Dissolved organic matter, Absorbance ratios.

Naturally occurring dissolved humic materials were fractionated according to molecular weight by dialysis and gel permeation chromatography. Components of higher molecular weight (greater

than 3500) absorbed strongly at 250 nm but fluoresced weakly, whereas humic fractions of lower molecular weight fluoresced intensely per unit absorbance. With appropriate precautions, fluorescence:absorbance ratios may be useful in delineating seasonal and depth distribution patterns of dissolved humic materials of low and high molecular weight. (Humphreys-ISWS) W80-06134

ROLE OF ADVECTIVE TERMS IN TIDALLY GENERATED RESIDUAL CIRCULATION, Institute of Ocean Sciences, Sidney (British Co-

For primary bibliographic entry see Field 2L. W80-06136

THE TRANSPORT OF A RADIOACTIVE SALT THROUGH A SEMI-INFINITE COLUMN OF POROUS MEDIUM: A PHYSICAL MODEL, California Univ. Livermore. Lawrence Livermore

Lab. J. N. Lucas.

Water Resources Research, Vol 16, No 2, p 387-390, April 1980. 3 Fig. 2 Tab, 9 Ref.

Descriptors: *Soil water movement, *Porous media, *Tracers, *Salts, Laboratory tests, Model studies, Mathematical models, Radioisotopes, Sodium, Aqueous solutions, Solutes, Sodium chloride, Soil water, Groundwater, Path of pollutants, Soil princes, Peachtenage present Soil science, Breakthrough curves.

A model study of the transport of radioactive A moder study of the transport of radioactive tracer through a porous medium was carried out in columns of sand into which a radioactive salt solution, sodium-24 chloride, was introduced continuously. Mathematical equations were developed to describe the effluent concentration, for a semi-infinite column, during the transient phase for variable as well as for the constant input concentration. Furthermore, inspection of the relevant equation for effluent concentrations from long columns indi-cated that dispersion should be negligible in the steady state. The experimental data of effluent sceaty state. The experimental data of enhance concentrations gave accurate agreement with the theoretical breakthrough curves predicted by the mathematical equations and with the steady state concentration value. (Sims-ISWS) W80-06141

TRACE METAL BUDGETS FOR A FORESTED WATERSHED IN THE NEW JERSEY PINE

WALENSTED IN THE NEW JERSEY BARRENS, Pennsylvania Univ., PA. Dept. of Geology. For primary bibliographic entry see Field 5A. W80-06144

THERMOHALINE INSTABILITY IN ANISOTROPIC POROUS MEDIA,
Oslo Univ. (Norway). Dept. of Mathematics.
For primary bibliographic entry see Field 2F.
W80-06151

5C. Effects Of Pollution

A LAYMAN'S GUIDE TO IRON BACTERIA PROBLEMS IN WELLS,

National Water Well Association, Worthington, S. Smith.

Water Well Journal, Vol 34, No 6, p 40-42, June, 1980. 5 Fig.

Descriptors: *Iron bacteria, *Water wells, Corrosion, Water pollution, Ground water, Disinfection, Chlorination, Sulfur bacteria, Ammonium compounds, Surfactants, Slime.

Iron bacteria cause corrosion, impart an unpleasant taste and odor to well water, reduce well capacity and service life, and eventually necessitate redevel-opment. They occur in two major forms: Gallion-ella and the Actinomycete group. Iron bacteria contribute to corrosion by using up the protective iron hydroxide coating on steel pipe, by providing a haven for sulfate reducing bacteria which pro-

duce corrosive by-products, and by enclosing and preserving galvanic corrosion sites. Most iron bacteria prefer a pH of 6 to 10, dissolved iron concentration from 0.01 to 4.0 ppm, 0.5 to 4.0 ppm dissolved oxygen, and a temperature range from 40 degrees to 60 degrees F. Iron bacterial contamination can be prevented by disinfecting anything that goes into the well. Chlorine is used due to its availability, low cost, ease of handling, and proven effectiveness. Chlorine in the form of calcium hypochlorite will flocculate bentonite, making it diffipochlorite will flocculate bentonite, making it diffi-cult to remove from the formation during develop-ment. Quaternary ammonium compounds kill bac-teria more effectively than hypochlorites. In addi-tion, they are excellent wetting agents capable of penetration into encrustation and out into the aquifer. Another effective disinfection method is to heat the water to 118 degrees F for ten minutes. (Purdin-NWWA) W80-06016

THE PHOSPHORUS-CHLOROPHYLL RELA-THOSHIP IN ROODEPLAAT DAM
Pretoria Univ., (South Africa). Dept. of Botany.
A. J. H. Fieterse, and D. F. Toerien.
Water SA (Pretoria), Vol 4, No 3, p 105-112, 1978. 4 Fig. 1 Tab. 27 Ref.

Descriptors: *Eutrophication, *Dams, *Phosphates, *Phosphorous, *Chlorophyll, *Algae, Tropic level, Limiting factors, Water quality, Nuterient requirements, Waste assimilative capacity, Water pollution sources, Impoundments, Standing waters, Distribution patterns, Mathematical models, Regression analysis, Water analysis, Variation of the control of ability, *South Africa.

The relationship between phosphate phosphorous (PO4-P) and chlorophyll a was investigated to establish a model for the eutrophication of the Roodeplaat Dam. Many of the impoundments in South Africa have excessive algae and/or macrophyte growths, which result in pooer water quality. Surface samples were taken at various points in ity. Surface samples were taken at various points in the dam and analyzed for inorganic nitrogen and phosphorous ions. Regression analysis of the aver-aged data indicated that algal growth was limited by the PO4-P concentration rather than by inorby the PO4-P concentration rather than by mor-ganic nitrogen. A reduction in the PO4 P concen-tration would then reduce algal growth and PO4 P concentration data is more applicable to South Africa conditions than Total P values. The signifi-cat relationship between chlorophyll a and PO4 concentrations upholds this conclusion. A model for eutrophication was developed for the Roode-later Demyshich was the applicable to circular plant Dam which may be applicable to similar bodies of water. Algal nuisance conditions can be bodies of water. Algal nuisance conditions can be expected to occur above a phosphate phosphorous concentration of 26 micrograms per liter. The eastern sections of the dam represented the upper threshold conditions for algal growth and phosphorous loading, probably because of loading via the Pienaars River. The trophic status and the intensity of eutrophication was accurately represented by the PO4-P parameter. (Sidney-IPA) W80-06037

GENETIC AND PHYSIOLOGICAL ADAPTA-TION OF THE COPEPOD EURYTEMORA AF-FINIS TO SEASONAL TEMPERATURES, Maryland Univ., Baltimore County, Catonsville. Dept. of Biological Sciences. For primary bibliographic entry see Field 2L. W80-06038

DELAYED BEHAVIORAL RESPONSES OF THE BALACKNOSE DACE (RHINICHTHYS ATRATULUS) TO CHLORAMINES AND FREE CHLORINE, Marland Univ., College Station. Center for Envi-

ronmental and Estuarine Studies. J. A. Fava, Jr, and Chu-fa Tsai.

Comparative Biochemistry and Physiology, Vol 60C, p 123-128, 1978, 3 Fig, 4 Tab, 18 Ref. OWRT B-006-MD(10),14-01-0001-1910.

Descriptors: *Chlorine, Effects, *Fish, *Toxicity, *Fish behavoir, *Blacknose dace, Chloramines, Free chlorine, Time avoidance index, Entry avoid-

Field 5-WATER QUALITY MANAGEMENT AND PROTECTION

Group 5C-Effects Of Pollution

Delayed behavioral responses of the blacknose dace to chloramines and free chlorine were studied for periods up to 220 min to demonstrate the importance of time as a factor in estimating the behavioral response. Concentrations used were 0.07 and 0.17 mg/l as total chlorine for chloramines and 0.07, 0.21 and 0.47 mg/l for free chloramines and avoided both chemicals at all concentrations studied. The latent period and median avoidance time of the fish to both chemicals decreased as the total chlorine concentration increased, and were shorter for chloramines than for free chloramine. The median avoidance time was shorter than the median lethal exposure time and much shorter than the median survival time. The results indicate the need to reference statements concerning the avoidance abilities of fish to the particular time required for such a response. Also, these fish have the capability to avoid chloramines and free chlorine in water before receiving a lethal dose, given the opportunity to readily find clean water. W80-06039

THE MEASUREMENT OF TEMPERATURE TOLERANCE: VERIFICATION OF AN INDEX, Maryland Univ., Baltimore County, Baltimore. Dept. of Biological Sciences.
For primary bibliographic entry see Field 2L.
W80-06041

ACUTE TOXICITY TO GOLDFISH OF MIX-TURES OF CHLORAMINES, COPPER, AND LINEAR ALKYLATE SULFONATE, Maryland Univ., Solomons. Chesapeake Biological Lab.

For primary bibliographic entry see Field 5A.

IRRIGATION RETURN WATER IMPACT ON SELECTED ATTACHED DIATOMS IN THE SACRAMENTO RIVER, CALIFORNIA, California Univ., Davis. Dept. of Land, Air, and Water Resources.

S. A. Ford, A. W. Knight, and D. E. Bayer. vailable from the National Technical Information Service, Springfield, VA 22161 as PB80-205586, Price codes: A05 in paper copy, A01 in microfiche. Water Science and Engineering Papers 4511, July 1980. 82 p., 6 Fig., 12 Tab. 1 Append. (California Water Resources Center UCAL-WRC-W-447).

Descriptors: *Irrigation water, *Return flow, *Biological communitis, *Diatoms, *Agricultural runoff, Irrigation, Groundwater, Surface waters, Environmental effects, Ecology, Water pollution effects, California, *SacramentoRiver(CA).

While a large percentage of applied irrigation water is consumed through evapotranspiration, enough returns to a ground and surface waters to make irrigated agriculture the largest contributor of waste water in the state. Unfortunately, little is known of the impact these irrigation drainage waters have on the biological communities receiving waters. The purpose of this study is to determine the effect of a large irrigation drain on the composition and density of the attached diatom community in the Sacramento River, California. Its objectives are to identify the dominant attached diatom apecies in the Sacramento river and the Colusa Basin Drain at Knights Landing during the irrigation season, to characterize the impacts of irrigation return water on the productivity and composition of the river's attached diatom community, and determine the physiochemical properties of the returns which are responsible for these impacts. (Snyder-Cal) W80-06080

SIZE-SELECTIVE PREDATION, LIGHT TRANSMISSION, AND OXYGEN STRATIFICATION: EVIDENCE FROM THE RECENT SEDIMENTS OF MANIPULATED LAKES, Wisconsin Univ.-Madison. Dept. of Geology and Geophysics.
For primary bibliographic entry see Field 2H. W80-06118

 $\mathsf{J}\mathsf{M}\mathsf{I}$

THE EFFECT OF MOISTURE ON PHOSPHORUS DIFFUSION IN COAL MINE SPOILS, North Dakota Univ., Grand Forks. Dept. of Phys-

J. W. Harrell, Jr, and M. Saeed. Soil Science, Vol 129, No 5, p 161-265, May 1980. 4 Fig, 2 Tab, 12 Ref. USDI G0264001.

Descriptors: *Phosphorus, *Diffusion, *Spoil banks, *Coal mines, Strip mines, Soil moisture, Moisture content, Soil, Soil types, Soil properties, Nutrients, Laboratory tests, Data processing, Regression analysis, Soil science, Strip mine reclamation.

Phosphorus diffusion coefficients (D) have been measured as a function of water tension (psi) and water content (theta) in topsoil and spoil samples from two coal mine sites in western North Dakota. For all four soils, the observed dependence of D upon psi and theta can be well decribed by equations of the form D = Ae to the (-a psi)power + B and D = K(theta -E) to the p power + B. The results showed that D is almost 0 for water contents below that held at 15 bars, and it increases rapidly as the water in excess of that held at 15 bars increases. For most of the measurements, D in the spoil materials, was greater than in the topsoils for a given moisture tension. (Sims-ISWS) W80-06188

ASSESSMENT OF THERMAL DISCHARGES ON ZOOPLANKTON IN CONOWINGO POND, PENNSYLVANIA,

Radiation Management Corp., Drumore, PA. Muddy Run Ecological Lab. D. Mathur, T. W. Robbins, and E. J. Purdy, Jr. Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 6, p 937 944, June 1980. 4 fig, 5

Descriptors: *Thermal pollution, *Water pollution effects, *Zooplankton, *Pennsylvania, Heated water, Powerplants, Cooling water, Sampling, Data processing, Statistics, Statistical methods, Regression analysis, Temperature, Water temperature, River flow, Plankton, Effects, Ponds, Powerplant impact, Conowingo Pond(PA).

Assessment of the impact of power station operation on zooplankton communities requires separation of natural variations from those due to the facility. Analysis of covariance (density of zooplankton at control station, ambient water temperature, and average daily river flow as covariats) proved powerful in separating the natural variations from those due to the operation of Peach Bottom Atomic Power Station (once-through cooling system) in Conowingo Pond, a 35.8-sq km impoundment on the lower Susquehanna River. The covariance technique overcame some of the problems associated with using ratio of density at control station to the density at an affected station to adjust for ambient variations. Significant differences in adjusted preoperational and postoperational means occurred but were not attributable to station operation. Multiple regression analysis indicated that an increase in zooplankton production, particularly in winter, would result with addition of heated water when river flows are less than 280 cu m/s. The zooplanktors were subjected to an average Delta T of 10.0 C in winter and up to 8.0 C in summer. Zooplankton population showed a great amount of resiliency in Conowingo Pond. (Sims-ISWS)

5D. Waste Treatment Processes

REMOVAL OF COLOR FROM PAPER MILL WASTE WATERS, Nalco Chemical Co., Oak Brook, IL. (Assignee). J. J. Syarz.

U.S. Patent No 4,179,329, 3 p, 6 Ref; Official Gazette of the United States Patent Office, Vol 989, No 3, p 990, December 18, 1979.

Descriptors: *Patents, *Waste water treatment, *Industrial wastes, *Pulp wastes, Color, Separation techniques, Chemical precipitation.

Color can be removed from paper mill waste waters by adding to the waste water, preferably at a pH within the range of about 2 to about 7, a relatively small amount of a polyethylene imine having a molecular weight of at least 300. The amount used is sufficient to form a complex solid of the imine with the color bodies which can then be separated by settling or filtration. The amount of the imine can be as low as 10 ppm with respect to the waste water or bleachery effluent and, in most cases, will not exceed 2,000 ppm, depending upon the particular imine employed. (Sinha-OEIS) W80-06017

MOVEMENT OF HEAVY METALS INTO A SHALLOW AQUIFER BY LEAKAGE FROM SEWAGE OXIDATION PONDS, Volcani Inst. of Agricultural Research, Bet-Dagan (Israel). Inst. of Soil and Water. For primary bibliographic entry see Field 5B. W80-06026

SYSTEM FOR ELECTROCATALYTIC TREAT-MENT OF WASTE WATER STREAMS, Omnipure, Inc., Houston, TX. (Assignee). W. A. Krause, and E. P. Shea. U.S. patent No 4,179,347, 7 p, 3 fig, 18 ref; Official Gazette of the United States patent Office, Vol 989, No 3, p 994-995, December 18, 1979.

Descriptors: *Patents, *Waste water treatment, *Sewage treatment, Water pollution treatment, Separation techniques, Electrolysis, Foaming, Foam separation, Skimming, Filtration, Organic wastes.

A continuous system for disinfecting waste water streams, such as sewage and streams containing organic matter and removing suspended solids is disclosed. A waste water stream is passed into an electrolytic cell open to the atmosphere and between a series of electrically charged parallel electrode plates. A controlled amount of electrolyte such as sodium chloride is added to the stream before it passes through the electrolytic cell. During passage between the electrode plates, a foam is generated which entrains suspended by skimning and/or suction means. The treated water discharged from the cell is filtered to remove additional non-nutrient suspended solids not entrained with the foam. A portion of the treated water from the electrolytic cell is recycled and reinjected into the influent stream. Control means are included to control residual chlorine in the effluent discharged while maintaining high dissolved oxygen in the effluent. W80-06028

REMOVAL OF CYANIDE FROM WASTE WATER,
Societe Nationale Elf Aquitaine, Paris (France).

Societe Nationale Elf Aquitaine, Paris (France) (Assignee).

J-P. Bernat.

U.S. Patent No 4,179,348, 5 p, 1 Fig, 14 Ref; Official Gazette of the United States Patent Office, Vol 989, No 3, p 995, December 18, 1979.

Descriptors: *patents, *Waste water treatment, *Industrial wastes, *Separation techniques, Water pollution treatment, Electrodialysis, Membrane processes, Oxidation, Cyanides.

A method and device for eliminating the cyanide ion from waste water by anodic oxidation uses an electrodialyzer. Water enters the anode compartment of the dialyzer, which is separated from the cathode compartment by a semi-permeable diaphragm permable to cations; an alkaline solution travels through the cathode compartment. No reagent is added. Thus CN- is oxidized in the anodic region of the electrodialyser, and the cations which have travelled through the diaphragm are simultaneously discharged at the cathode. In this manner, the CN, ions are eliminated at the same time as the cations in the waste water, provided that the water for treatment flows through the anode compartment at a rate in proportion to the electric current flowing in the electrodialytic cell. In addition, the PH has to be monitored in the two

Waste Treatment Processes—Group 5D

compartments. On the other hand, the auxiliary water conveyed through the cathode compartment is given a suitable salt content and pH for the cations to be dialysed in normal manner, the cations being discharged at the cathode. (Sinha-OEIS) W80-06029

RESEARCH ON NOVEL SOLVENT EXTRACTION SYSTEMS FOR INDUSTRIAL WATER

REUSE.

Bend Research, Inc., OR.

Available from the National Technical Information
Service, Springfield, VA 22161 as PB80-207301,
Price codes: A05 in paper copy, A01 in microfich.

Final Report to the Office of Water Research and Technology, October 1979. 93 p, 52 Fig, 7 Tab, 22 Ref. OWRT C-80033-R(8808)(1). 14-34-0001-8808.

Descriptors: *Solvent extraction, *Ion exchange, *Metals, *Separation techniques, Chromium, Cation exchange, Industrial water, *Water reuse, Water treatment

The objective of this program is to develop solvent-impregnated microporous beads for the extraction of metal ions from industrial waste waters traction of metal roles from mutustrial waste waters to yield reusable water. Several metal finishing waste streams were identified and investigated in preliminary studies. Various liquid ion-exchange agents were screened for each waste stream in agents were screened for each waste stream in order to find a satisfactory agent for use in the beads. Chromium, nickel, and acid-zinc plating rinse waters were selected as the most promising applications. The performance of the beads was applications in performance of the course of the contract. Improvements included reduction of bead size, increased bead production rate, and development of beads from different polymers. Several bead column optimization studies were per-formed, which were designed to improve metal capacity or kinetics. It was found that the chemical nature of the diluent significantly influenced ex-traction kinetics. The concentration of active agent traction kinetics. The concentration of active agent in the agent-diluent mixture was also significant. Although the beads are in an early stage of development, they compare favorably with a cation-exchange resin in the treatment of a synthetic nickel plating solution. Beads developed for chromium removal exhibit rapid exchange kinetics, but a low total capacity. a low total capacity. W80-06032

INDUSTRIAL WATER REUSE WITH COUP-LED TRANSPORT MEMBRANES. Bend Research, Inc., OR. Available from the National Technical Information Service, Springfield, VA 22161 as PB80-206014, Price codes: A05 in paper copy, A01 in microfiche. Final Report to the Office of Water Research and Technology, September 1979. 91 p., 51 Fig, 6 Tab, 12 Ref. OWRT C-80139-R(8802)(1). 14-34-0001-8802

Descriptors: *Ion transport, *Membrane processes, *Metals, *Separation techniques, Membranes, Water purification, Chromium, Copper, Industrial Water reuse, Water treatment, Ion ex-

The objective of this program is to develop coupled transport membranes for the treatment of in-dustrial wastewaters, allowing water reuse. Several metal-containing waste streams from the primary metals industry were identified as potential candi-dates for the application of coupled transport mem-branes. These membranes consist of a liquid ion-exchange agent constrained within the pores of a exchange agent constrained within the potes of a microporous polymeric support, forming a liquid membrane. Coupled transport was successfully demonstrated with flat sheet membranes for syn-thetic rinse solutions of chromium, zinc, and copper. Chromium was concentrated by a factor of nearly 10,000 from a dilute feed solution to a oncentrated product solution, indicating excellent potential for recovery of a concentrated product. The composition of the diluent used to dilute the liquid ion-exchanger in the membrane had a major effect on the metal ion flux. The flux-limiting step in metal transport was determined to be membrane diffusion, rather than reaction kinetics. The most

promising metal waste stream applications were also studied with hollow fiber membranes, which comprise a more favorable geometry for industrial application of coupled transport. Chromium and zinc exhibited the highest fluxes. The economics of coupled transport membranes for the recovery of metal values and reuse of rinse waters appears to he favorable.

WATER QUALITY CONTROL AND MANAGE-MENT OF ANIMAL WASTES THROUGH CUL-TURE WITH SELECTED FISHES,

TÜRE WITH SELECTED FISHES,
Illinois Natural History Survey, Urbana.
D. H. Buck, and R. J. Baur.
Available from the National Technical Information
Services as PB80-206188, Price codes: A07 in
paper copy, A01 in microfiche. Water Resources
Center, University of Illinois, Research Report
151, April 1980. 118 p, 6 Fig. 35 Tab, 55 Ref.
OWRT A-083-ILL(4), 14-34-001-8015.

Descriptors: *Biological treatment, *Waste treatment, *Carp, Fish, Primary productivity, Water pollution control, Water quality control, Animal wastes, Ponds, Chinese carp, Polyculture.

This study evaluated the contributions of four Chi-This study evaluated the contributions of four Chi-nese carps to the biological treatment of organical-ly polluted waters. Results established that through consumption of large quantities of organic matter, both living (plankton, bacteria) and dead (detritus, feces), the four carps in proper densities can signifi-cantly improve the quality of organically polluted waters and that properly designed systems would have practical application for small communitis, livestock producers, and food processors. Four Chinese carps were added to the four oxidation nonds receiving swine wastes. The carps used commerce carps were added to the four containants ponds receiving swine wastes. The carps used were chosen for their feeding habits: the silver carp (Hypophthalmichthys molitrix) filters uspended materials; the bighead carp (Aristichthys nobilis) filters zooplankton; the grass carp (Ctenonobins) inters zoopiankton; the grass carp (Cteno-pharyngodon idella) ingests coarse vegetation; the common carp (Cyprinus carpio) consumes benthos and detritus including fish feces. The study was conducted in four segments, spanning a total of four years, using different variables in each segment. W80-06034

PROCESS FOR TREATING WASTE WATER, Sumitomo Durez Co. Ltd., Tokyo (Japan). (Asig-

nee;. E. Sumi. U.S. Patent No 4,179,365, 4 p, 1 Tab, 11 Ref; Official Gazette of the United States patent Office, Vol 989, No 3, p 1000, December 18, 1979.

Descriptors: *Patents, *Waste water treatment, *Water polllution treatment, Organic wastes, Phenols, Separation techniques, Activated sludge, Microorgan

A process treats waste liquor or waste water containing phenols by means of activated sludge. Excess free phenols essentially harmful to aerobic bacteria and fungi present in the activated sludge are removed by means of a phenol recovery plant. The resulting effluent is treated in a large condi-tioning tank bringing the resulting liquor in contact with activated sludge, preferably under a low BOD load, to obtain a clan trated water through the function of microorganisms. The treated water through the function of microorganisms. The treated water is recycled to a large conditioning tank thereby achieving preliminary treatment of the waste water, an approach toward a closed system treatment of waste water. (Sinha-OEIS) W80-06036

METHOD FOR THE BIOLOGICAL PURIFICA-TION OF EFFLUENT AND THE PLANT FOR CARRYING OUT THE PROCESS Union Carbide Corp., New York. (Assignee).

J. R. Kaelin.
J. R. Kaelin.
U.S. Patent No 4,179,366, 7 p, 4 Fig, 8 Ref; Official Gazette of the United States Patent Office, Vol 989, No 3, p 1000, December 18, 1979.

Descriptors: *Patents, *Waste water treatment, *Water pollution treatment, *Water purification,

Oxygen, Oxygenation, Activated sludge, Equipment, Flow.

Effluent to be biological purified is poured serially through three interconnected tanks with the first two tanks acting as activation tanks and the last two tanks acting as a cross-clarification tank. After the concentration of activated sludge in the first tank has dropped to a predetermined value, the flow through the tanks is reversed so that the last tank, through the tanks is reversed so that the last tank, previously the post clarification tank, acts as one of the activation tanks and the first tank, previously one of the activation tanks, acts as the post clarification tank, which the middle tank continues to operate as the other of the activation tanks. An aerator is provided in each tank and the aerators in the first activation tanks are the control to the control tank and the certains in the first activation tanks. the first and last tanks are switched on or off depending upon the direction of flow of effluent. (Sinha - OEIS) W80-06059

POLYMER TO AGGLOMERATE RESOLVED

EMULSIONS, Nalco Chemical Co., Oak Brook, II. (Assignee). R. L. Bradley, and F. A. Mauceri. U.S. Patent No. 4,179,369, 6 p. 1 Fig. 2 Tab, 2 Ref. Official Gazette of the United States Patent Office, Vol 989, No 3, p 1001, /December 18, 1979.

Descriptors: *Patents, *Waste water treatment, *Water pollution treatment, *Industrial wastes, Oil pollution, Emulsions, Separation techniques, Oil

A method of resolving a water-in-oil sludge (emulsion) to separate an oil phase and a water phase, comprises the steps of treating the sludge while being agitated with a demulsifying agent to break the emulsion and an acrylamide polymer to hold the separate phases resolved. (Sinah-OEIS) W80-0605

ASSESSMENT OF SEWAGE LAGOONS AS PO-TENTIAL FISH CULTURE SITES IN WEST CENTRAL WISCONSIN,

CENTRAL WISCONSIN, Wisconsin Univ.-LaCrosse. Dept. of Biology. S. P. AveLallemant, and J. W. Held. Available from the National Technical Information Service, Springfield, VA 22161 as PB80-204662, Price codes: A05 in paper copy, A01 in microfiches, Water Resources Cener, University of Wisconsin, Madison Technical Report WIS WRC 80-10, 1980. 83 p. 1 Fig. 41 Tab, 101 Ref. OWRT-A-078-WIS(1), 14-34-0001-8053, 14-34-0001-9053

Descriptors: *Waste water, *Sewage effluents, Effluents, *Waste water treatment, Oxidation lagoons, *Sewage lagoons, *Aquicultue, Minnows, Fish farming, Bait fishing, Lagoons.

The potential of wastewate treatment lagoons in The potential of wastewate treatment lagoons in Wisconsin for culturing fathead minnows (Pimphales promelas) was considered. The efficacy of this treatment strategy in terms of improving effluent water quality by reclaiming nutrients in the form of fish biomass and reducing treatment costs by providing marktable bait fish was assessed. Wastewater lagoon systems located in 19 counties in west-central Wisconsin were assessed as potential fish culture sizes during 1978, and 1979. Decide fish culture sizes during 1978, and 1979. in west-central Wisconsin were assessed as poten-tial fish culture sites during 1978 and 1979. Deci-sions were based on field masurements of tempera-tue and dissolved oxygen (DO), number of la-goons, loading rates, and 24-hr, on-site cage bioas-says with fathead minnows. Water samples for chemical and phytoplankton analyses were collect-ed every 2 weeks from May through September at 10 of the facilities during 1979. Successful fish culture in wastewater treatment lacons annears to 10 of the facilities during 1979. Successful fish culture in wastewater treatment lagoons appears to depend on the loading rate and design capacity of the facilities considered. High levels of amonianitrogen and low levels of DO were major limitations to fish culture in sewage lagoons. Characteristis of lagoon systems with a high probability of culture success include moderate loading rates, pertreatment of waste, and seration. Fish culture in wastewater lagoons may provide a harvestable byproduct which could help offset operating costs. W80-06076

DEVICE FOR PURIFICATION OF LIQUIDS.

Field 5-WATER QUALITY MANAGEMENT AND PROTECTION

Group 5D—Waste Treatment Processes

L. A. H. Hakansson. U.S. Patent No 4,179,376, 5 p, 1 Fig, 13 Ref; Official Cazette of the United States Patent Office, Vol 989, No 3, p 1004, December 18, 1979.

Descriptors: *Patents, *Waste water treatment, *Industrial wastes, *Water pollution treatment, Separation techniques, Flocculation, Chemical precipitation, Filtration, Equipment, Filters.

A device for purification of liquids, especially waste water from industrial processes includes a flocculation chamber having means for a supply of a flocculant, a precipitation or sedimentation chamber for separation of the precipitate and a filter unit for further purification. The filter unit sarranged as an annular filter array having substantially radially arranged, inclined lamellas and is slidably and rotatably arranged on a vertical outlet tube in the precipitation or sedimentation chamber. The filter array is provided with a float member which keeps it in predetermind height relative to the surface of the liquid. The flocculation chamber comprises an annular, upwardly open channel and is arranged around the filter array. A cylindrical casing having apertures is arranged between the filter array and the annular flocculation chamber and is arranged to slowly rotate around the outlet and is arranged to slowly rotate around the outlet. and is arranged to slowly rotate around the outlet tube so that the filter array follows the casing in its rotational movement. (Sinha-OEIS) W80-06172

PROCESS AND APPARATUS FOR WASTE WATER TREATMENT,
Mitsubishi Rayon Co. Ltd., Tokyo (Japan). (As-

augney. H. Onishi, R. Numazawa, and H. Takeda. U.S. Patent No 4,181,604, 7 p, 2 Fig, 2 Tab, 3 Ref; Official Gazette of the United States Patent Office, Vol 990, No 1, p 248, January 1, 1980.

Descriptors: *Patents. *Waste water treatment. *Water pollution treatment, Organic wastes, Biological treatment, Aerobic bacteria, Microorganisms, Oxygen, Equipment, Hollow fi

Waste water containing organic pollutants is purified by biological treatment with aerobic microorganisms supported on hollow fibers having microporous walls through which oxygen is supplied to the microorganisms. The hollow fibers have an outside diameter of 0.01-3 mm. The microorganisms. issues are supported on the outside of the hollow fibers by introducing oxygen into the interior of them. Waste water is supplied to the exterior of the hollow fiber. (Sinha-OEIS)

VACUUM SEWAGE SYSTEM, Burton Mechanical Contractors, Inc., Rochester, IN. (Assignee).

B. E. Foreman, and M. A. Jones U.S. Patent No 4, 179, 371, 6 p, 6 Fig, 2 Ref; Official Gazette of the United States Patent No 989, No 3 p 1001-1002, December 1979.

Descriptors: *Patents, *Waste water treatment, *Water pollution treatment, Sewage treatment, Equipment, Flow, Sewerage, Vacuum systems.

The invention relates to sewage systems which utilize differential air pressure to create flow in contrasts to conventional gravity-operated and positive pressure sewer systems. The invention is directed to providing apparatus and a method for transporting a sewage mass from a source to a collection means. A pressure differential is maintained between these Sauvage injected into a collection means. A pressure differential is maintained between them. Sewage is injected into a conduit and forms a hollow cylinder. When no sewage is being transported, the conduit has substantially the same pressure throughout. Injector means are provided which is a valve opened in response to a predetermined condition. (Sinha-OHS) W80-06181

APPARATUS FOR THE TREATMENT OF WASTEWATER,

Dravo Corp., Pittsburgh, PA. (Assignee). E. S. Savage, and J. J. Chen.

 $\mathsf{I}\mathsf{M}\mathsf{L}$

U.S. Patent No 4,179,374, 7 p, 2 Fig, 8 Ref; Official Gazette of the United States Patent Office, Vol 989, No 3, p 1003, December 18, 1979.

Descriptors: *Patents, *Waste water treatment, *Water pollution treatment, Sewage treatment, Anaerobic conditions, Denitrification, Nitrates, Oxidation, Filters, Equipment.

An apparatus for the treatment of wastewater has an enclosed unit providing a faculative zone where a mixture low in dissolved carbon comprising raw a mixture low it dissolved actions companie as wewage and partially processed sewage undergoes denitrification brought about by faculative organisms contained in the prevailing low oxygen environment. Effluent from the faculative zone is charged into an enclosed columnar oxidation unit where a controlled flow of air or oxygen oxidizes nitrogen compounds present in raw sewage into nitrates. Part of the effluent from this columnar nitrates. Part of the effluent from this columnar oxidation unit, where the limited flow of oxygen has been mostly consumed in oxidizing the nitrogen compounds and is low in dissolved oxygen, is recycled to the faculative zone and part flows into a columnar denitrification zone where anaerobic microorganisms substantially completely remove nitrogen as gas from the nitrates producing an effluent with a low nitrate content. Columnar oxidation units and denitrification units are in essentially deep-hed filters. Also the faculative zone is tially deep-bed filters. Also the faculative zone is provided in a columnar unit. (Sinha-OEIS) W80-06193

5E. Ultimate Disposal Of Wastes

REGIONAL GROUND WATER FLOW NEAR A HIGH-LEVEL RADIOACTIVE WASTE RE-

Dames and Moore, Los Angeles, CA For primary bibliographic entry see Field 2F.

A MODEL TO ASSESS MIGRATION FROM SHALLOW LAND BURIAL FACILITIES.

Dames and Moore, Los Angeles, CA. For primary bibliographic entry see Field 7C. W80-06019

POTENTIAL SUBSURFACE ZONES FOR LIQUID-WASTE STORAGE IN FLORIDA Geological Survey, Tallahassee, FL. Water Resources Div J. A. Miller.

Florida Bureau of Geology Map Series 94, 1979. 1 Sheet, 4 Fig, 9 Ref.

Descriptors: *Subsurface mapping, *Liquid wastes, *Underground waste disposal, *Waste storage, *Florida, Injection wells, Deep wells, Aquifers, Hdyrogeology, Saline water, Aquitards, Planning.

Deep-well injection of liquid wastes into saline aquifers in Florida can be an alternative to surface disposal in some areas. However, conditions for deep-well injection are not suitable everywhere. General subsurface geohydrologic conditions are General subsurface geohydrologic conditions are described for the State of Florida, and areas are delineated where subsurface zones occur that appear capable of accepting injection from a single deep well at a rate of 1 million gallons per day without excessive pressure buildup in the receiving zone or injection well. All zones mapped contain water with a dissolved-solids concentration greater than 10 000 milliprame per liter and are bounded. than 10,000 milligrams per liter and are bounded above and below by low-permeability materials. The northern and central peninsular parts of Florida are the least suitable areas for waste injection. In the western panhandle of the State, an extensive sand of low to moderate permeability is a potential injection zone. In southern peninsular Florida, two high permeability zones found in carbonate rocks extend over large areas and, where they contain saline water, are the most suitable injection zones in the State. (Kosco-USGS) W80-06057

5F. Water Treatment and **Ouality Alteration**

WATER TREATMENT FOR SMALL PUBLIC SUPPLIES, New Mexico Water Resources Research Inst., Las

Cruces. H. G. Folster, D. B. Wilson, S. Hanson, and R.

Duran.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-202930, Price codes: A04 in paper copy, A01 in microfiche. WRRI Report No 119, February 1980. 54 p, 10 Tab, 4 Append. OWRT T-0009(7515)(3).

Descriptors: *Water treatment, *Reverse osmosis, *Electrodialysis, *Desalination processes, *Chemical precipitation, Conductivity, Salinity, New Mexico, Heavy metals, Cadmium, Mercury, Zinc, Equipment, Variability.

Reverse osmosis and electrodialysis water treatment techniques were applied to saline water in San Jon and Alamogordo, New Mexico. Laboratory studies of selective cation removal by precipitation to remove trace heavy metals in water sup-plies were continued. The mobil van unit containpines were communed. The moon wan unit containing the water treatment equipment was moved from San Jon to Alamogordo. Electrodialysis of water at San Jon reduced the salinity from 1000 ppm to 87 ppm, and reverse osmosis decreased the conductivity from 1300 to 220 (SW, spiral wound nodule)/ 30 (HFF, hollow fine fiber). Water recovers after the treatment processes support from 78 to revy after the treatment processes ranged from 78 to 85%. Desalting at Alamogordo reduced the salinity from about 1300 ppm to about 78 ppm and reverse osmosis reduced the conductivity from about 1880 to 130 (SW)/120 (HFF). Sulfide preabout 1880 to 130 (SW)/120 (HFF). Sulfide pre-cipitation of heavy metal cations (cadmium, mer-cury, and zinc) was performed on the water sam-ples and analysis of variance or F-tests were car-ried out for each set of rate data. Precipitation rate was found to be most significant at pH 9 and an increase in temperature above 10 degrees C re-duced the precipitation rate. All of the chemical analyses and operation logs of both locations are reported in tabular form. (Sidney-IPA) W80-06007

A LAYMAN'S GUIDE TO IRON BACTERIA PROBLEMS IN WELLS, National Water Well Association, Worthington,

OH

For primary bibliographic entry see Field 5C. W80-06016

THE APPROPRIATE TECHNOLOGY OF PROMOTING SAFE WATER SUPPLY IN AFRICA, Ahmadu Bello Univ., Zaria (Nigeria). B. Z. Diamant.

Aqua, No 3, p 0047-0049, 1980. 1 Tab, 17 Ref.

Descriptors: *Water supply development, *Public health, *Safety, *Water quality, Water purification, Waste water treatment, Sewage treatment, Technology, Planning, Decision making, Political aspects, Firtration, Chlorination, Social aspects, Irrirgation, Wells, Monitoring, Maintenance, *Africa.

Possible solutions and factors influencing the development of safe water supplies in Africa are discussed. Safe water is a major issue in Africa and it is estimated that only 1 out of 3 African rural people will drink disease-free water in 1980. The problem mainly affects the rural areas where \$3%. problem mainly affects the rural areas where 83% of the African people live. The planning of safe water supply development should take into account national policy, sociological considerations, simultaneous approaches, water supply, water treatment, and surveillance. National policy should involve simultaneous programs of safe water and adequate waste disposal. The appropriate technology should be employed such as simple hand pumps and shallow dug wells so that the people will accept it and be able to easily operate the equipment. Roof catchments of corrugated metal are excellent for collecting safe drinking water and are excellent for collecting safe drinking water and also for improving housing. Proper waste disposal program are necessary to prevent contamination

Evaluation Process—Group 6B

of the water supply. Waste water can be used effectively in most cases for crop irrigation. Slow sand filtration and bleaching powder chlorination are simple forms of water treatment. The success of a safe water development program will also depend on effective surveillance, health checks and maintenance. (Sidney-IPA)

WATER SOFTENING SYSTEM,

J. W. Braswell.
U.S. Patent No 4,181,605, 10 p, 10 Fig, 8 Ref;
Official Gazette of the United States Patent Office,
Vol 990, No 1, p 248-249, January 1, 1980.

Descriptors: *Patents, *Water treatment, *Water quality control, *Water softening, Ion exchange, Resins, Control systems, Instrumentation, Waste dilution, Regeneration.

The water softening system employs a treatment tank containing a mineral bed of ion-exchange resin granules, a brine tank, and a a valve for periodically cycling water throgh the mineral bed for removing hardness and other undesirable factors. A diluted brine solution is passed through the bed in an opposite direction to its normal service flow to recondition and flush the bed. The control for the system includes electrically operated solenor the system includes electrically operated soin-noid diaphram valves, and a plunger valve respon-sive to water pressures, for controlling and regular-ing the flow of water and brine through the miner-al bed. A venturi aspirator is incorporated in the plunger valve whereby a saturated brine solution is drawn and with controlled dilution is caused to flow in a direction opposite to service flow through the mineral bed. (Sinha-OEIS)

5G. Water Quality Control

REGULATION OF LAND USE PRACTICES FOR AREAS SURROUNDING AQUIFERS - ECONOMIC AND LEGAL IMPLICATIONS, Connecticut Univ., Storts. Inst. of Water Resources. For primary bibliographic entry see Field 6E. W80-06002

MANAGEMENT MODEL OF A GROUND WATER SYSTEM WITH A TRANSIENT POL-

WATER SYSTEM WITH A TRANSIENT FUL-LUTANT SOURCE, Stanford Univ., CA. Dept. of Geology. S. M. Gorelick, I. Remson, and R. W. Cottle. Water Resources Research, Vol 15, No 5, p 1243-1249, October, 1979. 6 Fig, 1 Tab, 12 Ref, 1 Append

Descriptors: *Water management(Applied), *Ground water, *Water quality, *Computer models, Pollutants, Approximation method, Water supply, Waste disposal, *Aquifer management.

This paper describes an aquifer management model to determine the maximum concentration allowable at a transient pollutant source to meet space-dependent ground water quality requirements. The model is demonstrated using a one-dimensional ground water system with a single pollutant source at an adjacent stream for single-period and repeated-period pollutant discharges. The Crank-Nicolson numerical approximation of the convective-dispersive equation is used in the management model. The pollutant source concentration is treated as a parameter in the resulting system of linear ed as a parameter in the resulting system of linear equations. The concentrations throughout the equations. The concentrations throughout the system are defined and manipulated as functions of this parameter for each time step. The parameter is this parameter for each time step. The parameter is maximized by comparison of ground water quality limits with the ground water solute concentration at the corresponding nodes. The final value of the parameter is the maximum concentration allowable in the source water over the management period. The' model is conceptually applicable to more complicated one-dimensional and two-dimensional problems. Any numerical approximation that generates a system of linear equations may be incorporated into the pollutant source model. The model enables ground water managers to balance water

supply and waste disposal needs while maintaining quality over long periods. (Purdin-NWWA) W80-06015

EVALUATION OF INDUCED INFILTRATION BETWEEN THE RIVER SKERNE AND THE MAGNESIAN LIMESTONE IN SOUTH EAST

Plymouth Polytechnic (England). Dept. of Civil Engineering. For primary bibliographic entry see Field 4B. W80-06020

GROUND WATER POLLUTION BY SEPTIC TANK DRAIN FIELDS, Washington Univ., Seattle. Dept. of Environmental Health.

F. B. DeWalle, and R. M. Schaff. Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 106, No EE3, p 631-648, June, 1980. 7 Fig. 5 Tab, 11 Ref.

Descriptors: *Water pollution, *Ground water, *Septic tanks, *Soil disposal fields, Washington, Sampling, Chemical analysis, Surface water, Cor-relation analysis, Coliforms, Pollutants, Cation exchange, Water quality.

This paper presents the results of a study on ground-water contamination by septic tank effluent in Central Pierce County, Washington. Chemical analyses were collected on 386 ground water samanalyses wele collected on 3-86 ground water samples from 98 wells with depths ranging from 210 feet to 1,064 feet and yields ranging from 10 gpm to 3,500 gpm. A correlational analysis showed high correlations among calcium, magnesium and bicarbonate and low values among nitrate, chloride, and sodium reflecting sewage effluent contamination. In unsewered areas with high septic tank density a In unsewered areas with high septic tank density a negative correlation was noted between calcium and sodium, possibly indicating a cation exchange. This hypothesis is supported by the observation that, over a 30-year period, there was a gradual increase of calcium and chloride concentration and an almost constant sodium content. Depth profiles similarly showed low sodium concentrations at all depths but high calcium and nitrate concentrations near the surface, decreasing to lower values at depth. The highest nitrate and coliform concentrations occur in the winter when infiltrating precipi-tation dissolves and leaches these contaminants downward. Restricting septic tank installation in densely populated areas will probably reduce the rate of ground water deterioration. (Purdin-NWWA) W80-06023

REGULATORY AND ENVIRONMENTAL IMPLICATIONS OF GROUND WATER HEAT PUMPS

National Water Well Association, Worthington, OH.

For primary bibliographic entry see Field 6E. W80-06030

MICROBIOLOGICAL ASSESSMENT OF RIVER WATER CONTAMINATION BY FISH

HATCHERY EFFLUENT, Oregon State Univ., Corvallis. Water Resources arch Inst.

Research filst. J. C. Leong, and J. L. Fryer. Report WRRI 66, March 1980. 165 p. OWRT C-7620(No 7251)(1), 14-34-0001-7251.

Descriptors: *Fish diseases, *Fish hatcheries, Hatchery effluent, *Viruses, Virus detection, *Sal-monoids, Fish casualties, Water quality, Water pol-

Since 1973, there has been at least one major viral Since 1973, there has been at least one inado viral epizootic at an Oregon fish hatchery each year. This research proposal is concerned with the microbiological quality of the water released into the Oregon watershed after a viral epizootic and the impact of releasing this virus-containing water on environment. The following research accomplish-ments were made: (1) Development of methods for concentrating IHNV and IPNV from water by

polymer two-phase separation and graduated pore-size membrane filtration, (2) Development of meth-ods to increase the sensitivity of laboratory meth-ods for detecting IHNV and IPNV by proper host cell selection and pretreatment of cells with poly-berne, (3) Development of models for the virus-carrier state in vitro, (4) Demonstration that IHNV will grow in mosquito cells. This result suggests an insect vector for IHNV transmission, (5) Demon-stration that IHNV will grow in mammalian cells at 16 C. However, no phenotypic mixing was stration that HNV will grow in mammalian cells at 16 C. However, no phenotypic mixing was observed in cell cultures doubly infected with VSV and IHNV, (6) U.V. irradiation of viruscontaining water was effective in eliminating IHNV and IPNV from the water in a flow-through system, and (7) Quantitation of the virus released in hatchery effluent water during an IHNV epizootic. This study has shown that large quantities of virus are released into the environment during spawning of infected fish and during a viral epizootic. This virus-contaminated water can be a contributing factor in maintenance and enbe a contributing factor in maintenance and en-largement of a virus-carrier population of fish in the wild. W80-06083

FLOTATION PUMP DEVICE,

R. J. Aide U.S. Patent No 4,179,243, 6 p, 3 Fig, 6 Ref; Official Gazette of the United States Patent Office, Vol 989, No 3, p 963-964, December 18, 1979

Descriptors: *Patents, *Aeration, *Water treatment, *Equipment, Water quality control, Pumps, Bodies of water, Lakes, Pumping.

The invention relates to aerating devices for aerating lakes, ponds, and reservoirs and the like. A pumping device is provided which has a telescoping pipe structure for pumping water from the bottom of a lake up to the surface of the lake. The telescoping pipe is pivotally mounted to a raft to pivot from horizontal to a vertical position so that the device may be installed into the lake by moving the raft and telescoping structure out onto the lake while the pipe is horizontal and then allowing the pipe to pivot to a vertical position when the raft has reached the desired location in the lake for pumping. (Sinha-OEIS)

6. WATER RESOURCES **PLANNING**

6B. Evaluation Process

DEMONSTRATION OF AN ANALY MODEL FOR ESTABLISHING WATER SOURCES DEVELOPMENT PRIORITIES, DEMONSTRATION OF ANALYTIC

SOURCES DEVELOPMENT PRIORITIES, Oblahoma Univ., Norman. Bureau of Water and Environmental Resources Research.
G. W. Reid, and T. W. K. Leung.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-204449, Price codes: A04 in paper copy, A01 in microfiche. Report, September 1979. 70 p, 28 Fig, 17 Tab, 16 Ref. OWRT A-089-OKLA(1).

Descriptors: *Priorities, *Water development, *Decision making, *Indexing, Economic feasibillity, Legisltion, resources development, Cost-benefit analysis, State governments, Economic justification, Environmental effects, Planning, Impound-ments, Budgeting, Comprehensive planning.

A priority system for Oklahoma water resource development projects based on an anlytical model is reported. Single Index and Double Index Approaches were used to develop the priority listings which may be very useful for the State decision maker in the funding of proposed water resources projects. Seven arbitrarily selected water projects (five impoundments and two water treatment faciltities) with adequate pertinent data were used for this study. Groundwater development projects were not included because they seldom contain enough useful data for decisions to be based on and the environmental assessment of such projects is quite controversial. Some initial computation was

Field 6—WATER RESOURCES PLANNING

Group 6B—Evaluation Process

necessary to convert the data from the projects into a usable form. From the data, a single composition score or priority index was generated by the Single Index Approach. Two indices, a demand index and a desirability index were given by the Double Index Approach and several cluster groups of projects were formd. The later approach seems to useful the model is flexible and it appears to the project useful the model is flexible and it appears. most useful, the model is flexible, and it appears that project type or size has no effect on the priority ranking. Data availability is critical for complete priority assessment. (Sidney-IPA) W80-06008

WATER RESOURCE PRESERVATION: PER-SONAL VALUES AND PUBLIC SUPPORT, Washington State Univ., Pullman. Dept. of Politi-I. C. Pierce

Environment and Behavior, Vol 11, No 2, p 147-161, June 1979, 3 Tab, 26 Ref. OWRT-A-069-WASH(5), 14-31-0001-5048.

Descriptors: *Water resources, *Preservation, *Aesthetics, *Social values, *Attitudinal surveys, Conservation, Social aspects, Surveys, *Washing-ton, Value, Water conservation, Public sector, En-vironment, Attitudes, Behavior, Motivation, Psychological aspects.

This article relates individual's personal values to Inis article relates individual's personal values to their support for water resources preservation; re-sults are dominated by a single-value-a world of beauty. Preference for a world of beauty enters into calculations of most types of people when supporting or opposing environmental quality. Re-sults suggest shared value perceptions implied by suits soggest stated value perceptions implied by environmental policy. However, a substantial por-tion of the variance in support for preservation remains unexplained. Separate analyses are re-quired to assess these idiosyncratic value relationquired to assess these intosynctatic value relationships with environmental policy alternatives. The relationship between personal values and support for water resources preservation was assessed from data obtained in a mail questionnaire survey of household heads in Washington State in 1974. Seven possible water use priorities were identified: agriculture, preservation, domestic, energy, indusagriculture, preservation, onestic, energy, indus-try, recreation, and transportation. Personal values were measured by the Milton Rokeach inventory. Water policy self-interest measures such as water-front property ownership and water resource use level were also included. Public orientations to water resource preservation are related to personal values. Values also more consistently relate to preservation support among individuals with greater self-interest in water resource policy. (Danovich-Wisconsin)

PRESENT METHODS AND PROSPECTIVES IN WATER METER READING AND BILLING (METHODES ACTUELLES ET PROSPECTIVES EN MATIERE DE RELEVE DES COMP-TEURS ET DE FACTURATION DES CONSOM-MATIONS D'EAU), Compagnie Intercommunale Bruxelloise des Eaux

(Belgium). A. Desmed.

Aqua, No 3, p 0055-0065, 1980. 3 Fig, 41 Ref. (English Sum

Descriptors: *Water measurement, *Optimization, *Instrumentation, *Automatic control, Water rates, Measurement, Cost-benefit analysis, Water costs, Wages, Decision making, Management, Economics, Projections, Planning, Cost repayment, Maintenance costs, Social aspects.

Several methods for the optimization of water meter reading and billing are discussed. The cost of remote meter reading and automatic meter reading is high, but a reduction in cost could result if is high, but a reduction in cost could result in water, gas, and electric meters were grouped together in one system. Manual reading costs have continued to increase because of wage increases and optimization of this system would entail cut-backs in the number of meters read, number of readings, and the institution of consumer self-reading. Efficiency could also be improved with complete automation in all aspects of data processing: reading, billing, and collection. The determination

JMI

of management thresholds will also be necessary to establish the economics of the available reading and billing methods, choice of water meters, methand olining metricols, choice of water meters, metricols of record keeping, frequency of reading, and maintenance. An automatic control system would be economically justified if the sum of the probability of an error time the consequences of the error was greater than the cost of the system. Decision makers should also pay special attention to the quality of service in relationship to the ent techniques employed. (Sidney-IPA)

OPTIMUM MANAGEMENT OF WATER METERS: WAYS AND MEANS, Societe Lyonnaise des Eaux et de l'Eclairage

Aqua, No 3, p 0066-0068, 1980. 7 Fig.

Descriptors: *Water measurement, *Instrumenta-tion, *Optimization, *Management, Water rates, Flow, Economics, Performance, Reliability, Water utilization, Planning, Variability, Cost-benefit anal-ysis, Maintenance costs, Water meters.

The precision of five types of volume water meters in five large urban areas in France was investigated to develop an optimized management policy for each water distribution system. Errors in the meter reading result from very low flow rates, leaks, differences between various models, or aging of the instrument. These factors tend to give an un-derestimation of the actual water consumption. At derestimation of the actual water consumption. At high flowrates (above 320 liters per hour), the age of the meter influenced the measurement error. About 7% of the water consumption was not measured because the flow was too low to be recorded. Replacement of old meters after more than ten years of service may be justified, but marginally economical. More tests of the influence marginany economical. More tests of the intuence of jammed meters and flowrates below 320 liters per hour will be performed in the future. (Sidney-IPA)
W80-06121

PUBLIC ATTITUDES TOWARD THE RECREATIONAL USE OF DRINKING WATER RESERVOIRS IN MASSACHUSETTS,

ssachusetts Univ., Amherst. Dept. of Landscape Massachusetts Univ., Amherst. Dept. of Landscape Architecture and Regional Planning. L. R. Klar, Jr., W. H. Bumgardner, and A. Ghirin. Available from the National Technical Information Service, Springfield, VA 22161 as PB80-207509, Price codes: A05 in paper copy, A01 in microfiche. Water Resources Research Center, University of Massachusetts Publication No 114, 1980. 72 p, 26 Tab, 23 Ref, 1 Append. OWRT A-107-MASS(1). 14-34-0001-9023.

Descriptors: *Multiple purpose reservoirs, *Recreation facilities, *Effects, *Water quality, *Potable water, Outdoor recreation, Outdoor recreation planning, Drinking water reservoirs, Quabbin reservoir, Recreation demand, Recreation user characteristics, Outdoor recreation policy, *Reservoir management, Recreation participation, Willingness to pay, Telephone survey, Water quality, Social survey, Prinking water managers. survey, Drinking water managers.

This study identified public attitudes among Massachusetts residents toward the recreational use of drinking water reservoirs including Quabbin Reservation, the state's largest water supply source. Results were compared to the findings of two related studies on the same topic. The first assessed attitudes among recreational users of Quabbin Reservation and the second surveyed attitudes of water supply managers. Data for this study were obtained through telephone interviews with 961 randomly selected adults throughout the state. Most people favored a moderate recreational use-level of reservoirs and support was expressed by a majority of respondents for a number of activities which are presently not allowed at Quabbin. Only 6 activities were not favored by a majority. Those classified as Quabbin users were especially in favor of certain activities. A majority of respondents stated that state funds should be used to finance recreation at drinking water reservoirs and that user fees were also appropriate. Paying a slight

increase in water bills was not seen as a viable increase in water bills was not seen as a viable funding method. There is a need to study current policies governing recreation at drinking water reservoirs in Massachusetts. The recreation carrying capacity of these resources should be studied to determine if present use levels can be increased without altering present treatment practices. W80-06157

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

DESALTING HANDBOOK FOR PLANNERS, Catalytic, Inc., Philadelphia, PA. For primary bibliographic entry see Field 3A. W80-06013

EFFICIENCY AND EQUITY IN MANAGEMENT OF AGRICULTURAL WATER SUP-

California Univ., Davis. Dept. of Agricultural

Economics.
R. E. Howitt, W. C. Watson, and C. F. Nuckton.
Available from the National Technical Information
Service, Springfield, VA 22161 as PB80-207699,
Price codes: A03 in paper copy, A01 in microfiche.
Giannini Foundation of Agricultual Economics,
Information Series 79-1 Bulletin 1892, March 1979,
29 p. 3 Fig. 3 Tab, 2 Append. (California Water
Resources Center Project UCAL-WRC-W-526).
OWRT-B-187-CAL(03).

Descriptors: *Agriculture, *Economics, *Mathematical models, *Groundwater, *Surface water, *Water supply, *Crop production, *Water costs, California, Irrigation efficiency, land, Energy,

This quadratic programming model is an irrigation orientated extension of a model developed by Adams, King, and Johnston and considers a possible 370 production activitis for nine field crops and 28 seasonal vegetable crops. The state of California is divided into 14 production regions each with is divided into 14 production regions each with two irrigable soil types. The regions are based on homogeneity of climate, soil type, and water costs and availability. Regional production activities are constrained by the physial availability of land, water, and, in a few cases, by processing capacity, maximum statewide production is also constrained for all commodities. Data on yields and production costs are from University of California Agricultural Extension Service estimates. Perennia' crops are not included in the model, but the available amounts of ground and surface water in the model were adjusted regionally to allow for perennial requirements. This additional constriction is consistent with state and federal water allocation policy decisions made in 1977. The model's objective function of maximizing consumers' surplus and producers' quasi-rent yields the optimum crop mix subject to constrained amounts of land, energy, and water. (Snyder-California).

CROP PRODUCTION AND WATER SUPPLY CHARACTERISTICS OF KERN COUNTY, California Univ., Davis. Dept. of Agricultural

Economics.

W. D. Watson, C. F. Nuckton, and R. E. Howitt.
Available from the National Technical Information
Service, Springfield, VA 22161 as PB80-205552,
Price codes: A06 in paper copy, A01 in microfiche.
Giannini Foundation of Agricultural Economics,
Information Series 80-1 Bulletin 1895, April 1980,
96 p. 19 Tab, 4 Plates, 1 Append. (California Water
Resources Center Project UCAL-WRC-W-526).
OWRT-B-187-CAL(4).

Descriptors: *Water supply, Agriculture, *Crop production, *Economics, *Irrigation, *Water costs, *Available water, Walter quality, California, *Kern County(CA).

An account of agricultural production in Kern county, California, is given in this report, with particular emphasis on that all-important component-water for irrigation. We have brought together in one place an abundance of informatin accu-

Data Acquisition—Group 7B

mulated over a two year period from many and diverse sources. The collection and arrangement of the data should prove directly useful to Kern County planners. It may also serve a broader purpose, for kern County water probems and possible solutions are paradigmatic of those in other parts of this semi-arid state in the not-too-distant future. The analysis of the water supply situation and water costs in Kern County, therefore, merits the attention of state-level warer strategists. Informatin was gathered both from published sources and from conversations with many experts. The histori-cal framwork of Kern County agriculture can be viewed as a series of production stabilization pla-teaus, for whenever the available water supply became a binding constraint, no additional acreage was irrigated. Then as more water became availa-ble, expansion occurred. Feasibility studies made prior to supplemental water projects and post-project evaluations were a main source of information. (Snyder-California) W80-06082

6E. Water Law and Institutions

REGULATION OF LAND USE PRACTICES FOR AREAS SURROUNDING AQUIFERS ECONOMIC AND LEGAL IMPLICATIONS. necticut Univ., Storrs. Inst. of

sources.

M. M. Huffmire, and F. C. Reitman.

Available from the National Technical Information
Service, Springfield, VA 22161 as PB80-202484,
Price codes: A02 in paper copy, A01 in microfiche.
Research Project Technical Completion Report,
1979. 19 p. OWRT A-082-CONN(1). 14-34-0001-

Descriptors: *Aquifers, *Ground water, *Aquifer protection, *Aquifer recharge areas, Aquifer management, Planning, *Connecticut, *Land use controls, *Cost-benefit analysis.

Evidence indicates that many of Connecticut's high yield aquifers are already contaminated and that without immediate action to restrict harmful surface practices, they will be followed by others. Economic evidence indicates that the State as a whole can reap substantial benefits by an intelliwhole can reap substantial openins of an inten-gently conceived and implemented program of land use monitoring and water resource planning, but that such a program can only be undertaken through additional legislation and funding. Current legal mechanisms for the orderly management of water resources are insufficient and need overhaul. Greater stress must be placed on long-term planning on the regional level, and strong institutional arrangements to implement this planning process are necessary. W80-06002

REGULATORY AND ENVIRONMENTAL IMPLICATIONS OF GROUND WATER HEAT

PUMPS, National Water Well Association, Worthington, T. F. Gass

Water Well Journs 1980. 1 Fig, 1 Tab. Well Journal, Vol 34, No 6, p 26-28, June,

Descriptors: "Heat pump, "Regulation, "Environmental effects, "Ground water, Effluents, Waste water disposal, Injection wells, Underground waste disposal, State governments, Local governments, Computer programs, Model studies, Aquifers, Heating, Cooling, Thermal pollution, Water quality, Water chemistry, On-site investigations

Regulations affecting the use of ground water heat pumps impose various requirements on well construction, ground water use and quality, and effluent disposal. Discharge of thermally altered water to surface water is regulated by the National Pollutant Discharge Elimination System while discharge to wells falls under the Federal Underground Injection Control Program. Ground water use regulations do not significantly affect heat pump growth. However, state and local regulations may impose severe restrictions on ground

water heat pump use. The National Water Well Association and the National Association of State Legislators are working with state officials to change existing regulations. The EPA awarded a contract to NWWA to assess the environmental implications of widespread ground water heat pump use. A computer program was developed to simulate the long-term thermal impact on nearly every type of hydrogeologic environment and with any heating and cooling loads. Temperature changes vary from 10 degree F within 10 feet of the return well to 1 degree F at a distance of 100 feet. If the ground water heat pump is used for both heating and cooling, the extent and degree of temperature alteration are greatly reduced. temperature alteration are greatly reduced. Changes in ground water quality and viscosity were not detected in a field demonstration. (Purdin-NWWA) W80-06030

EFFICIENCY AND EQUITY IN MANAGEMENT OF AGRICULTURAL WATER SUP-

California Univ., Davis. Dept. of Agricultural Economics. For primary bibliographic entry see Field 6C. W80-06081

CROP PRODUCTION AND WATER SUPPLY CHARACTERISTICS OF KERN COUNTY, California Univ., Davis. Dept. of Agricultural Economics. For primary bibliographic entry see Field 6C. W80-06082

6F. Nonstructural Alternatives

THE IMPACT OF NONSTRUCTURAL FLOOD

THE IMPACT OF NONSTRUCTURAL FLOOD ABATEMENT MEASURES ON PATTERNS OF INDUSTRIAL LOCATION,
Shippensburg State Coll., PA. Dept. of Economics and Management Science.
D. D. Singer, and J. W. Kohn.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-202526, Price codes: A07 in paper copy, A01 in microfiche. Institute for Research on Land and Water Resources The Pennsylvania State University University Park. Research Project Technical Completion Report, June 1980, 123 p, 6 Fig. 20 Tab, 88 Ref. OWRT A-052-PA(1). 14-34-0001-9040.

Descriptors: *Flood plains, *Floods, *Industries, *Abatement, Model studies, Flood damage, Stormflow, Rainfall, Streamflow, Runoff, Land use, Evapotranspiration, Groundwater, Population, Coal mines, *Susquehanna River Basin, *Simulation model, Computer program, Stage feet function, Damage function, Hydrologic characteristics, Sto-

This report outlines the hydrologic and economic characteristics of the Susquehanna River Basin, and analyzes flood damages and the effect of non-structural flood abatement measures. A new method of estimating flood damages is needed, since current methods do not allow for the actual nature of flood risk and are inherently biased against the use of nonstructural relative to structural flood damage abatement measures. Actual patan nood damage abatement measures. Actual pat-terns of industrial location in the Susquehanna River Basin are examined, and modifications made to the theory of industrial location under the threat of flood. The report concludes that the location of an industrial facility in a flood plain reflects, under many circumstances, rational behavior on the part of the firm. Proximity to markets and rail transportation provide significant market economies for industry. Existing flood damage abatement systems rely excessively on structural relative to nonstruc-tural measures; the greater use of nonstructural measures would reduce the risk associated with the location and encourage the industrial use of such land. (Tsong-Pa) W80-06011

POST-FLOOD RECOVERY AND HAZARD MITIGATION: LESSONS FROM THE MASSA-CHUSETTS COAST, FEBRUARY, 1978,

Massachusetts Univ., Amherst. Dept. of Geology

Massachusetts Univ., Amherst. Dept. of Georoby and Geography. R. H. Platt, and G. M. McMullen. Available from the National Technical Information Service, Springfield, VA 22161 as PB80-207517, Price codes: A06 in paper copy, A01 in microfiche. Water Resources Research Center, University of Massachusetts Publication No. 115, 1980. 101 p, 4 Eq. 11.7ab. 44 Ref. Fig, 11 Tab, 44 Ref.

Descriptors: *Floods, *Floodplains, Coast, Natural hazard, Storms, Disaster, *Flood damge, *Flood plain insurance, Flood plain zoning, Hazards, Watershed protection and flood prevention act, Massachusetts, *Flood recovery help, Flood insurance.

Responsibility for response to flood disasters has historically evolved from reliance on privare, local and state efforts to a predominantly federal role. The federal government now expends billions of dollars annually for flood protection, emergency relief and long-term recovery. U.S. flood policy has emerged in thre stages: (1) the Structual Era; (2) Unified Floodplain Management; and (3) Post-Flood Mitigation. State 3, represents an integrated response to bloodplain management, utilizing structural and nonstructural controls, and focusing on the prevention of repetitive losses. The Great blizzard and Coastal Flooding of February 1978 was one of the most devastating natural disasters to strike New England in modern times. Although damage assessments vary widely, over 25,000 homes were affected and over 300 destroyed in Responsibility for response to flood disasters has damage assessments vary widely, over 25,000 homes were affected and over 300 destroyed in Massachusetts. Private domstic losses were valued at \$172.4 million; natural resource losses, \$7 million; Federal Disaster Assistance Administration (FDAA) costs for coordination, relief, and recovery were \$190 million. This diaster provided the opportunity to assess out national commitment to reducing flood losses. Federal, state and municipal programs for land acquisition/relocation, wetland protection and restriction, and post-disaster regulations fo reconstruction were tested. Despite the early optimism of some public officials, no 'high risk coastal property was publicly acquired and no families were publicly relocated from disaster areas. Many of the affected structures were allowed to be rebuilt without elevation and floodproofing because they were deemd not to have sustained damage beyond 50% of their pre-storm fair market value. The Mass. Wetlands Protection Act yielded some mitigation benefits due to local Conservation Commission efforts.

W80-06156

6G. Ecologic Impact Of Water Development

ESTROGEN SEX REVERSAL OF TILAPIA AUREA, Auburn Univ., AL. Dept. of Fisheries and Allied For primary bibliographic entry see Field 8I. W80-06035

7. RESOURCES DATA

7A. Network Design

FLUID FLOW IN NATURALLY FRACTURED RESERVOIRS, Rice Univ., Houston, TX. Dept. of Geology. For primary bibliographic entry see Field 2F. W80-06024

7B. Data Acquisition

A FIELD EXERCISE ON GROUND WATER FLOW USING SEEPAGE METERS AND MINI-PIEZOMETERS, PIEZUMETERS, Waterloo Univ. (Ontario). Dept. of Earth Sciences. D. R. Lee, and J. A. Cherry. Journal of Geological Education, Vol 27, No 1, p 6-10, January, 1980. 4 Fig. 1 Tab, 8 Ref.

Descriptors: *Education, *Hydrog *Ground water movement, *Piezometers, *Hydrogeology,

Field 7—RESOURCES DATA

Group 7B-Data Acquisition

age, *Instrumentation, *On-site data collections, Water quality, Pollutants, Hydrologic data, Limnology, Lake beds, Streams, Estuaries, Surfaceground water relationships.

Basic principles of hydrogeology and surface-ground water relationships were clearly demon-strated to university students with the aid of two inexpensive devices: a miniature piezometer and a seepage meter. These two devices provide information on the flow net, the flux and velocity of water moving along the flow lines at and near the interface, and ground water quality. Student investigations can involve the identification of ground water inflow or outflow areas in lakes, streams, or estuaries, measurement of the spatial and temporal variations in seepage flux through bottom sedi-ments, identification of zones of subsurface pollut-ant migration into surface waters, measurement of the ground water component of the water budget of a lake or pond, or the role of ground water in fluvial erosion and deposition. The construction and use of the mini-piezometers and seepage meters are described in detail. Construction materials can be acquired for less than 25 dollars. In a matter of a few hours, the devices can be installed, monitored, and removed. (Purdin-NWWA) W80-06014

DRILL PROVIDES UNMIXED SAMPLES. World Water, Vol 3, No 4, p 39, April, 1980. 1 Fig.

Descriptors: *Dual-tube drilling, *Rotary drilling, *Drilling samples, Water loss, Operating costs, Collapse.

A new rotary drilling method, dual-tube drilling, provides accurate data on potential yield of aquifers by drawing up unmixed continuous formation samples. In addition, it has lower operating costs and results in straighter holes with fewer washout zones. This method is based on the use of double-walled or concentric flush-jointed drill pipe. The hole-cleaning air or fluid is circulated down the annulus between the inner and outer pipes to the drill bit where it flushes the samples up through the center tube at high velocity. Since the outer tube supports the hole, surface casing can be outer tube supports the hole, surface casing can be eliminated. This system can maintain circulation even while drilling in caving or fractured strata. Jual-tube drilling can use a variety of rotary bits, but favors top-head drive rigs overrotary table rigs. The high penetration rates with this system results in lower costs. In some cases costs for drilling and sampling have been cut by 70 percent. (Purdin-NWWA) W80-06045

DRAFT, CONSTRUCTION AND OPERATION OF A SEQUENTIAL RAIN SAMPLER, Utrecht Rijksuniversiteit (Netherlands). Inst. voor

Meteorologie en Oceanografie.
W. A. H. Asman.
Water, Air, and Soil Pollution, Vol 13, No 2, p
235-245, June 1980. 10 Fig, 2 Tab, 11 Ref.

Descriptors: *Sampling, *Chemistry of precipita-tion, Rainfall, Equipment, Design, Water chemis-try, Rain gages, Rainfall intensity, Chemicals, Cal-cium, Chloride, Sodium, Nitrogen, Sulfur, Pollut-ants, path of pollutants, Water pollution, Sequen-

Sequential sampting of rain on a volume basis presents fewer problems than sampling on a time basis. The optimum diamenter of the collector opening depends on the rainfall statistics, the size of the sample needed for chemical analysis, and the of the sample needed for chemical analysis, and the total number of samples that has to be collected. The sampler described in this paper consists of a square polyethylene funnel of 0.64 sq m and a fraction collector with 250 polypropylene tubes of 39 ml, which is activated by a rain detector. Each fraction corresponds to about 0.05 mm of rainfall. The funnel is covered by a roller blind that automatically rolls up when it starts to rain. Evaluation of the system leads to the conclusion that the collector opening can be made smaller (by 0.20 sq m), that the measured rainfall rate depends on the averaging time, and that all other surfaces of the sampling setup should be covered with inert material. (Sims-ISWS)

IMI

W80-06084

RAIN DROP SIZES AND RAINFALL RATE MEASURED BY DUAL-POLARIZATION RADAR,

RADAR, Ruthrford and Appleton Lab., Slough (England). M. P. M. Hall, S. M. Cherry, J. W. F. Goddard, and G. R. Kennedy. Nature, Vol 285, No 5762, p 195-198, May 22, 1980. 5 Fig. 1 Tab, 7 Ref.

Descriptors: *Rainfall, *Radar, *Remote sensing, Particle size, Ice, Snow, Hail, Spatial distributions, Rainfall intensity, Equipment, Instrumentation, Mesurement, Meteorology, Dual-polarization

A rapidly switched dual-polarization radar technique was used for the first time to obtain two-dimensinal spatial distributions of the statistical characteristics of the sizes and concentration of raindrops in rain. These were obtained using a high-resolution 10-cm wavelength radar, and the data were used to estimate rainfall rates within small volumes to a much greater accuracy than is available from conventional radar measurements. The technique also gave a clear distinction be-tween ice particles and raindrops. (Sims-ISWS)

DIURNAL RAINFALL VARIATION IN NORTHEAST BRAZIL,
Conselho Nacional de Desenvolvinento Científico e Technologico, Rio de Janeiro (Brazil); and Instituto de Pesquisas Espaciais, Sao Jose dos Campso (Brazil)

For primary bibliographic entry see Field 2B. W80-06094

PERFORMANE OF V.H.F. AERIALS CLOSE TO A SNOW SURFACE, British Antarctic Survey, Cambridge (England). For primary bibliographic entry see Field 2C. W80-06098

RUNOFF SYNTHESIS USING LANDSAT AND SCS MODEL, Maryland Univ., College Park. Dept. of Civil En-

gineering. or primary bibliographic entry see Field 2E. W80-06131

A SAMPLER FOR COHESIVE SEDIMENT IN THE BENTHIC BOUNDARY LAYER,

THE BENTHIC BOUNDARY LAYER, University Coll. of Swansea (Wales). Dept. of Chemical Engineering. R. Bryant, D. J. A. Williams, and A. E. James. Limnology and Oceanography, Vol 25, No 3, p 572-576, May 1980. 3 Fig, 3 Ref.

Descriptors: *Sampling, *Equipment, *Sediments, On-site tests, Instrumentation, Suspended solids, Foreign research, *Wales, Benthic boundary layer.

A sampling apparatus for collecting sediment sus-pensions from the benthic boundary layer has been developed and tested. Samples are collected in evacuated pressure-resistant bottles by activation of solenoid valves used to release the vacuum. The behavior of the apparatus with respect to water velocity was assessed from direction and inclinometer sensors attached to its main frame. The apparatus has been tested at a depth of 30 m in the Bristol Channel in water velocities of 1-2 m/s. Profiles of suspended sediment in the boundary layer were derived from gravimetric analysis of the samples collected. An important characteristic of the sampler is that under conditions of apprecia-ble water movement, samples are collected from the oncoming water and not from a self-induced turbulent field. However, this would not be true in calm water. (Humphreys-ISWS) W80-06132

AN AUTOMATED SYSTEM FOR MEASURING SOIL WATER POTENTIAL GRADIENTS IN A RHIZOTRON SOIL PROFILE.

Science and Education Administration, Auburn, For primary bibliographic entry see Field 2G. W80-06185

PROFILE SOIL MOISTURE FROM SURFACE MEASUREMENTS, Science and Education Administration, Beltsville, MD. Hydrology Lab. For primary bibliographic entry see Field 2G. or primary /80-06200

7C. Evaluation, Processing and Publication

USER'S GUIDE TO UIMIP AND MTRX, Idaho Univ., Moscow. Dept. of Agricultural Engi-

Idaho Univ., Moscow. Dept. of Agricultural Engineering.
K. H. Yoo, and J. R. Busch.
Available from the National Technical Information
Service, Springfield, VA 22161 as PB80-202476,
Price codes: A06 in paper copy, A01 in microfiche.
Idaho Water Resources Research Institute, University of Idaho Partial Research Technical Completion Report, May 1980. 103 p, 4 Fig, 9 Ref, 4
Append. OWRT B-041-IDA(1).

Descriptors: *Linear programming, *Algorithms, *Computer programs, Programming languages, Data processing, Mathematical models, Operations research, Economics, Optimization

systematic discussion of the UIMIP integer linear programming program is presented in this user's manual. Users should have a basic knowluser's manual. Users' should have a basic knowledge of linear programming, mathematical programming, algorithms, and FORTRAN programming. Direct access files are used to reduce the computer memory size required for integer solutions and intermediate tableau and row and column identification tables are saved on a disk file during the integer solution. An integer programming problem as large as a continuous programming problem can be solved on a computer of a given size, but more CPU time is necessary for file assessment. A revised simplex method could cut down computing time and core size requirements. down computing time and core size requirements. The organization of the program is described in detail and the four calling programs for subroutine (DEFINE FILE, DIMENSION, DOUBLE PRE-CISION, and DATA) are discussed. The data input formats, coding procedures and examples, and illustrations of a proper card deck are present-ed and guidelines for efficient use and error correction are included. A matrix generating program (MTRX) for UIMIP is available. Sample solutions for a small and a large sized problem are included. (Sidney-IPA) W80-06006

MANAGEMENT MODEL OF A GROUND WATER SYSTEM WITH A TRANSIENT POL-

LUTANT SOURCE, Stanford Univ., CA. Dept. of Geology. For primary bibliographic entry see Field 5G. W80-06015

A MODEL TO ASSESS MIGRATION FROM SHALLOW LAND BURIAL FACILITIES, Dames and Moore, Los Angeles, CA.
O. I. Oztunali, and A. E. Aikens.

Dames and Moore Engineering Bulletin 50, p 21-30, December, 1979. 4 Fig, 7 Tab, 6 Ref, 1

Descriptors: *Computer models, *Radioactive waste disposal, *Landfills, *Mass transfer, Migration, Hazardous wastes, Radioisotopes, Aquifer characteristics, Dispersion, Model studies.

A mass transport model for shallow-buried hazard-ous wastes is described. Criteria for model devel-opment and required factors are outlined. The model assumes a stationary, homogeneous, and iso-tropic porous medium with a saturated and unsatu-rated zone containing an incompressible fluid of constant viscosity. The model was applied to migration of radioactive and nonradioactive hazard-

Evaluation, Processing and Publication—Group 7C

ous wastes from a shallow landfill. Results of the radioactive waste simulation for four different sites show that the effectiveness of each site depends on the radionuclides to be disposed of and on each site's particular combination of hydrogeological and radiochemical characteristics. The model can be related conceptually to other dispersion meth-odologies and discharge surfaces and is ideally suited for comparative quantitative evaluations and sensitivity analyses. It can be simplified for a single-zone problem and can be extended to timesingle-zone problem and can be extended to time-dependent sources. It is not limited by the magni-tude of space and time considerations. It can evalu-ate a given site, select the most suitable site among several candidates, or determine the extent of engineering or waste quantity limitations on the sou term. (Purdin-NWWA) W80-06019

SINGULARITIES IN DARCY FLOW THROUGH POROUS MEDIA, Cornell Univ., Ithaca, NY. School of Civil and Environmental Engineering. For primary bibliographic entry see Field 2F. W80-06021

GROUND WATER SIMULATION USING A ONE DIMENSIONAL FLOW MODEL, Youngstown State Univ., OH. Dept. of Civil Engi-

Water Resources Bulletin, Vol 15, No 6, p 1618-1627, December, 1979. 6 Fig, 3 Tab, 7 Ref. OWRT-C-6301(No 5229)(4).

Descriptors: *Ground water movement, *Water quality, *Computer models, Simulation analysis, quality, *Co Steady flow.

A simple quantity and quality flow simulation model is presented which requires much less computer time and storage than complex two-dimension flow models and gives reasonably accurate results. The model divides the saturated zone into excitone durant the length of a river. Each exciton is sections along the length of a river. Each section is homogeneous and isotropic with respect to the permeability of the unconfined aquifer. Average water table elevation and aquifer thickness in a section can be used with Darcy's law to determine steady state flow for or into that section. The quality of water can be represented by the average TDS value in any section, and dispersion effects are ignored. The model simulated the ground water basin in San Luis Rey River in Southern California and results were compared with those of a USGS model. It was found that the simple model gave results which were consistently within five percent of the USGS model results. Thus, one dimensional ground water flow models can be useful tools in the initial planning process where high accuracies are not required, and considerable time and money can be saved. (Purdin-NWWA)

WATER RESOURCES DATA FOR TEXAS, WATER YEAR 1978-VOLUME 1. ARKANSAS RIVER BASIN, RABINE RIVER BASIN, NECHES RIVER BASIN, TRIN-ITY RIVER BASIN, AND INTERVENING COASTAL BASINS,

Geological Survey, Austin, TX. Water Resources

Geological Survey Water-Data Report TX-78-1, October 1979. 645 p, 1 Fig.

Descriptors: *Texas, *Hydrologic data, *Surface waters, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Data collections, Sites, *Arkansas River basin, *Red River basin, *Sabine River basin, *Sabine River basin.

Surface-water data for the 1978 water year for Texas are presented in three volumes, appropriately identified as to content by river basins. This volume (volume 1) includes the Arkansas River, Red River, Sabine River, Neches River, Trinity River, and intervening Coastal basins. Data consist of records of stage, discharge, and water quality of

streams and canals; and stage, contents, and water streams and cannas; and stage, contents, and water quality of lakes and reservoirs. Also included are crest-stage and flood-hydrograph partial-record stations, reconnaissance partial-record stations, and low-flow partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are pubsystematic data-collection program, and are pub-lished as miscellaneous measurements. Records for a few pertinent stations in bordering States are also included. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperation State and Fed-eral agencies in Texas. (Kosco-USGS) W80-06048

WATER RESOURCES DATA FOR TEXAS, WATER YEAR 1978--VOLUME 2, SAN JA-CINTO RIVER BASIN, BRAZOS RIVER BASIN, SAN BERNARD RIVER BASIN, AND INTERVENING COASTAL BASINS,

Geological Survey, Austin, TX. Water Resources Div. Geological Survey Water-Data Report TX-78-2, October 1979. 515 p, 1 Fig.

Descriptors: *Texas, *Hydrologic data, *Surface waters, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Data collections, Sites, *San Jacinto River basin, *Brazos River basin, *San Bernard

Surface-water data for the 1978 water year for Texas are presented in three volumes, appropriately identified as to content by river basins. This volume (volume 2) includes the San Jacinto River, Volume (Volume 2) includes the San Jackino Kiver, Brazos River, San Bernard River and intervening Coastal basins. Data consist of records of stage, discharge, and water quality of streams and canals; and stage, contents, and water quality of lakes and reservoirs. Also included are crest-stage and flood-hydrograph partial-record stations, reconnaissance partial-record stations, and low-flow partial-record stations. Additional water data were collected at stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. Records for a few pertinent stations in bordering States are also included. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Rederal agencies in Texas. (Kosco-USGS)

WATER RESOURCES DATA FOR TEXAS, WATER YEAR 1978--VOLUME 3, COLORADO RIVER BASIN, LAVACA RIVER BASIN, GUADALUPE RIVER BASIN, RIO GRANDE BASIN, AND INTER-URING COASTAL BASINS BASIN, RIO GRANDE DESCRIPTION OF THE PROPERTY OF THE PROPERTY

Geological Survey Water-Data Report TX-78-3, October 1979. 595 p, 1 Fig.

Descriptors: "Texas, "Hydrologic data, "Surface waters, "Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Data collections, Sites, "Colorado River basin, "Lavaca River basin, "Guadalupe River basin, "Nueces River basin, "Rio Grande basin.

Surface-water data for the 1978 water year for Surface-water data for the 1978 water year for Texas are presented in three volumes, appropriately identified as to content by river basins. This volume (volume 3) includes the Colorado River, River, Guadalupe River, Nueces River, Rio Grande, and intervening Coastal basins. Data consist of records of stage, discharge, and water quality of streams and canals; and stage, contents, and water quality of lakes and reservoirs. Also included are crest-stage and flood-hydrograph partial-record stations, reconnaissance partial-record stations, and low-flow partial-record at various sites. ditional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. Records for a few pertinent stations in bordering

States are also included. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Texas. (Kosco-W80-06050

MAPS SHOWING GROUND-WATER CONDI-TIONS IN THE HOPI AREA, COCONINO AND NAVAJO COUNTIES, ARIZONA-1977, Geological Survey, Tucson, AZ. Water Resources

C. D. Farrar

C. D. Parrar.

Available from OFSS, Box 25425, Fed. Ctr.
Denver, CO. 80225. Paper copy \$16.00, microfiche
\$2.00. Geological Survey open-file report 80-3
(WRI), January 1980. 4 Sheets, 16 Ref.

Descriptors: *Maps, *Groundwater resources, *Arizona, *Aquifer characteristics, *Water wells, Water levels, Water quality, Water analysis, Dissolved solids, Fluorides, Water yield, Hydrogeology, *Coconino County(AZ), *Navajo

The Hopi area includes about 3,200 square miles in nne rhopi area incidues about 3,200 square linies in ortheastern Arizona and is mostly in the Navajo and Hopi Indian Reservations. Ground water occurs in several aquifers that are made up of one or more formations. The main sources of ground water are the Coconino aquifer, the Chinle Formation, the N and D aquifers, the Toreva and Bidahocobi Economics and the allumines Ground Bidahocobi Economics. chi Formations, and the alluvium. Ground-water development has been slight; in 1977 about 425 acre-feet of ground water was withdrawn in the Hopi area. Information on the maps includes a designation of the principal aquifer that furnishes water to wells, depth to water, altitude of the water level, and chemical quality of the water. Scale 1:125,000. (Kosco-USGS)

GENERALIZED CONFIGURATION OF THE BOTTOM OF THE FLORIDAN AQUIFER, SOUTHWEST FLORIDA WATER MANAGE-MENT DISTRICT.

Geological Survey, Tallahasses, FL. Water Resources Div.

sources Div.

R. M. Wolansky, G. L. Barr, and R. M. Spechler.

Available from OFSS, Box 25425, Fed. Ctr.

Denver, CO. 80225. Paper copy \$2.50, microfiche
\$0.50. Geological Survey open-file report 79-1490

(WRI), 1979. I Sheet, 22 Ref.

Descriptors: *Maps, *Aquifers, *Florida, *Water levels, Water wells, Aquicludes, Geohydrologic units, Groundwater barriers, Hydrogeology, *Floridan aquifer, *Southwest Florida Management District

This map presents the configuration of the bottom of the Floridan aquifer in the Southwest Florida Water Management District. The bottom of the Water Management District. The bottom of the aquifer generally corresponds to the beginning of consistent intergranular evaporites occurring in either the Avon Park, Lake City, or Oldsmar Limestones of Eocene age. The altitude of the bottom of the aquifer varies from about 600 feet below the National Geodetic Vertical Datum of 1929 in the north to about 3,000 feet below the datum in the South. (Kosco-USGS)

GENERALIZED THICKNESS OF THE CON-FINING BED OVERLYING THE FLORIDAN AQUIFER, SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT, Geological Survey, Laguna Niguel, CA. Water Percenter Dist

Geological Survey, Laguna Niguel, CA. Water Resources Div. A. Buono, R. M. Spechler, G. L. Barr, and R. M. Wolansky. Available from OFSS, Box 25425, Fed. Ctr. Denver, Co. 80225. Paper copy \$2.50, microfiche \$0.50. Geological Survey open-file report 79-1171 (WR(), 1979. I Sheet. 17 Ref.

Descriptors: *Maps, *Aquicludes, *Aquifers, *Florida, Geohydrologic units, Aquifer characteristics, Groundwater barriers, Hydrogeology, *Floridan aquifer, *Southwest Florida Management District.

Field 7-RESOURCES DATA

Group 7C—Evaluation, Processing and Publication

This map presents the thickness of the confining bed overlying the Floridan aquifer in the Southwest Florida Water Management District and adjacent areas. The bed separates the surficial aquifer from the underlying Floridan aquifer. Lithologic logs and information from quarries were used in conjunction with an unpublished map to compile this map at 1:250,000 scale. Units included in the confining bed are: clay, sandy clay and marl, undifferentiated with respect to age, the Hawthorn Formation, and the unconsolidated sections of the Tampa Limestone. (Kosco-USGS)

CLASSIFICATION OF GROUND-WATER RE-CHARGE POTENTIAL IN THREE PARTS OF SANTA CRUZ COUNTY, CALIFORNIA, Geological Survey, Menlo Park, CA. Water Resources Div.

For primary bibliographic entry see Field 4B. W80-06056

WATER-QUALITY DATA FOR CANALS IN EASTERN BROWARD COUNTY, FLORIDA,

Geological Survey, Tallahassee, FL. Water Resources Div.

sources Div.

W. H. Sonntag.

Available from the OFSS Box 25425, Fed. Ctr.
Denver Co 80225, paper copy \$21.25, microfiche
3.50. Geological Survey open-file report 80-68,
1980. 161 p, 2 Fig, 8 Tab, 1 Ref.

Descriptors: "Water quality, "Canals, "Florida, "Basic data collections, "Chemical analysis, Surface waters, Environmental effects, Urban runoff, Monitoring, Nutrients, Pesticides, Trace elements, Bottom sediments, Coliforms, "Eastern Broward

Increased urbanization in Broward County has contributed to canals being used as receptacles for urban wastes, sewage effluent, and stormwater runoff. The introduction of contaminants into the canals may affect the water quality. In 1959 the U.S. Geological Survey, in cooperation with the Broward County Pollution Control Board and the South Florida Water Management District, began South Florida water Management District, began to monitor the water-quality in canals of eastern Broward County. This report presents selected water-quality data collected from the canals, October 1974 through September 1978, in eastern Broward County. (Kosco-USGS)

SURFICIAL GEOLOGY OF PULASKI QUAD-RANGLE, OSWEGO COUNTY, NEW YORK, Geological Survey, Ithaca, NY. Water Resources

T. S. Miller, and E. H. Muller.

Available from the OFSS Box 25425, Fed. Ctr. Denver Co 80225, paper copy \$1.75, microfiche \$50. Geological Survey open-file report 79-1343 (WRI), 1979. 1 Sheet.

Descriptors: *Geology, *Maps, *New York, *Petrology, *Groundwater potential, Glacial aquifers, Water wells, Natural resources, *Oswego County(NY).

The location and extent of 14 kinds of surficial deposits in Pulaski quadrangle, Oswego County, N.Y., are mapped on a 7.5 minute U.S. Geological Survey topographic quadrangle map. The map was prepared to indicate the lithology and potential for ground-water development at any specific location. (Kosco-USGS) W80-06062

WATER-QUALITY I OREGON STREAM BA DATA FROM

Geological Survey, Portland, OR. Water Re-

sources Div. T. L. Miller.

IMI

Available from the OFSS Box 25425, Fed. Ctr. Denver, Co 80225, paper copy \$13.00, microfiche copy \$3.50. Geologica Survey open-file report 79-1335, 19179. 98 p, 6 Fig. 6 Tab, 5 Ref.

Descriptors: *Water quality, *Data collections, *Oregon, *Streams, *Small watersheds, Low flow, Monitoring, Water analysis, Hydrologic data.

The U.S. Geological Survey collected water-quality data in five Oregon stream basins during summer low-flow conditions in 1977 and 1978. During the two sampling periods, a total of 18 different sites were sampled Several sites were sampled in both 1977 and 1978. Included in the sampling were diel trace of dissolved oxygen, temperature, specific conductance, pH, and solar radiation. In addition, periphyton and benthic invertebrate samples were collected and identified. (Kosco-USGS) USGS) W80-06067

GEOHYDROLOGIC DATA FOR THE LOWER WOOD RIVER GROUND-WATER RESER-VOIR, RHODE ISLAND, Geological Survey, Providence, RI. Water Re-sources Div. D. C. Dickerman, and P. J. Silva. Rhode Island Water Resources Board Water Infor-mation Series Report 4, 1980. 193 p, 26 Fig, 1 Plate, 24 Tab, 8 Ref.

Descriptors: "Hydrogeology, "Hydrologic data, "Groundwater resources, "Rhode Island, "Aquifer characteristics, Data collections, Sites, Stratigraphy, Water resources development, Test wells, Observation wells, Lithologic logs, Water levels, Particle size, Sampling, Chemical analysis, Water quality, Seismology, Resistivity, "Lower Wood River, Ground-water resersovir(RI) "Pawcatuck River basin(RI), Stratified-drift deposits.

Geohydrologic data were collected in a 31.0-square-mile study area in southern Rhode Island, which includes the Lower Wood River ground-water reservoir. The data, which are mainly limited to the stratified-drift aquifer, are presented in tabular form and are being used by the Rhode Island Water Resources Board in planning and developing the ground-water resources of the Pawcatuck River basin. The data include descriptions of the depths, yields, and construction features of 424 selected wells and test holes; lithologic logs of 193 wells and test holes; particle-size distribution for 290 lithologic samples, description distribution for 290 lithologic samples, description 12 aquifer tests, velocity and layer thickness at 44 seismic shot points, apparent resistivity at 21 sites, water-level data; surface-water-quality data, lowflow discharge measurements; and stream dis-charge data. Chemical analyses of water samples from 198 selected wells and test holes are also from 198 selected wells and test holes are also included. The location of data-collection sites and the area underlain by stratified-drift deposits are shown on a two part plate on a 1:12,000 scale topographic base map. Figures show the location of aquifer test sites, pumping wells, observation wells, and generalized lithologic logs of well (Kosco-USGS)
W80-06068

WATER RESOURCES DATA FOR CONNECTI-CUT, WATER YEAR 1979, Geologial Survey, Hartford, CT. Water Resources

Available from the National Technical Information Service, Springfield, VA 22161 as PB80-193410, Price codes: A17 in paper copy, A01 in microfiche. Geological Survey Water-Data Report CT-79-1, April 1980. 366 p, 4 Fig, 1 Tab.

Descriptors: *Connecticut, *Hydrologic data, *Surface waters, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Water wells, Water levels, Data collections, Sites.

Water resources data for the 1979 water year for Connecticut consist of records of stage, discharge, and water quality of streams; stage, conrents, and and water quanty of streams, stage, cornents, and water quality of lakes and reservoirs; and water levels and water quality of ground-water wells. This report contains records for water discharge at 56 gaging stations; tidal volume at 1 gaging station; stage only at 2 tidal-gaging stations; stage only at 1

gaging station; contents at 36 Lakes and reservoirs; gaging station; contents at 36 Lakes and reservoirs; water quality at 50 gaging stations, 5 lakes and reservoirs, 2 harbors, 34 wells and 1 spring; and water levels at 66 observation wells. Also included are 41 creat-stage partial-record stations. Additional water data were collected at various sites not part of the systematic data-collection program and are published as miscellaneous mesuremens and analyses. A few pertinent stations (not included above) in bordering States are also included in this report. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Connecticut. (Kosco-USGS)

WATER RESOURCES DATA FOR WISCON-SIN, WATER YEAR 1979, Gelogical Survey, Madison, WI. Water Resources

Div. Available from the National Technical Information Service, Springfield, VA 22161 as PB80-195589, Price codes: A23 in paper copy, A01 in microfiche. Geological Survey Water-Data Report WI-79-1, April 1980. 514 p, 5 Fig.

Descriptors: *Wisconsin, *Hydrologic data, *Surface waters, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Water wells, Water levels, Data collections, Sites.

Water-resources data for the 1979 water year for Wisconsin include records of streamflow at gaging stations, partial-record stations, and miscellaneous sites; records of reservoir storage; records of chemical, physical, and biological characteristics of surface water, ground water, and precipitation, and records of water levels in observation wells. Records for a few gaging stations in bordering States also are included. These data represent that part of the national Water Data System collected by the U.S. Geological Survey and cooperating State and Federal agencies in Wisconsin. (Kosco-USGS) USGS) W80-06161

WATER RESOURCES DATA FOR NEBRASKA,

WATER YEAR 1979, Geological Survey, Lincoln, NE. Water Resouces

Div. Available from the National Technical Information Service, Springfield, VA 22161 as PB80-200157, Price codes: A22 in paper copy, A01 in microfiche. Geological Survey Water-Data Report NE-79-1, May 1980. 501 p, 5 Fig, 3 Tab.

Descriptors: *Nebrask, *Hydrologic data, *Surface waters, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Water wells, Water levels, Data collections, Sites.

ater resources data for the 1979 water year for Water resources data for the 1979 water year for Nebraska consist of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs; and water levels and water quality in wells and springs. This report contains discharge records for 161 gaging stations; stage and contents for 10 lakes and reservoirs; water quality for 60 gaging stations, 10 ungaged stations, 34 partial-record flow stations, and 276 wells; and water levels for 63 observation wells. Also included are 7 creat-stage partial-record stations. Addidate of the creat-stage partial-record stations. Addidated are 7 creat-stage partial-record stations. Addidated are 7 creat-stage partial-record stations. Addidated for the creat-stage partial-record stations. water levels for 63 observation wells. Also includitional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Nebraska. (USGS)

WATER RESOURCES DATA FOR NEW YORK, WATER YEAR 1979-VOLUM 1. NEW YORK EXCLUDING LONG ISLAND, Geological Survey, Albany, NY. Water Resources

Evaluation, Processing and Publication—Group 7C

Available from the National Technical Information Service, Springfield, VA 22161 as PB80-195928, Price codes: A24 in paper copy, A01 in microfiche. Geological Survey Water-Data Report NY-79-1, May 1980. 538 p, 8 Fig, 1 Tab.

Descriptors: *New York, *Hydrologic data, *Surface waters, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Water wells, Water levels, Data collections, Sites.

Water resources data for the 1979 water year for New York consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of ground-water wells. This volume contains records for water discharge at 187 gaging stations, stage only at 22 gaging stations, stage and contents at 12 gaging stations, and 18 other lakes and reservoirs, water quality at 60 gaging stations and 43 wells, and water levels at 44 observation wells. Also included are data for 132 crest-stage and 15 low-flow partial-record stations with the state of th 133 crest-stage and 15 low-flow partial-record sta-tions. Additional water data were collected at var-ious sites not involved in the systematic data-col-lection program and are published as miscellaneous measuremens and analyses. These data together with the data in volume 2 represent that part of the national Water Data System operated by the U.S. Geological Survey and cooperating State, local, and Federal agencies in New York. (Kosco-USGS) W80-06163

WATER RESOURCES DATA FOR NEW YORK, WATER YEAR 1979--VOLUME 2. LONG

Geological Survey, Albany, NY. Water Resources

Div. Available from the National Technical Information Service, Springfield, VA 22161 as PB80-192891, Price codes: A14 in paper copy, A01 in microfiche. Geological Survey Water-Data Report NY-79-2, April 1980. 306 p, 8 Fig, 1 Tab.

Descriptors: *New York, *Hydrologic data, *Surface waters, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment Gaging stations, Streamflow, Flow rates, occurrent transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Water wells, Plata collections, Sites, *Long

Water resources data for the 1979 water year for New York consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservois; water quality of precipitation; and water levels and water quality of ground water wells. This volume contains rec-ords for water discharge at 17 gaging stations; ords for water discharge at 17 gaging stations; water quality at 17 gaging stations, 610 wells, and 3 precipitation stations; and water levels at 130 observation wells. Also included are data for 79 lowflow partial-record stations. Additional water data were collected at various sites not involved in the systematic data-collection program, and are published as miscellaneous measurements and analyses. These data together with the data in Volume 1 represent that part of the national Water Data System operated by the U.S. Geological Survey in cooperation with State, Federal, and other agencies in New York. (Kosco-USGS) W80-06164 flow partial-record stations. Additional water data

WATER RESOURCES DATA FOR SOUTH DAKOTA, WATER YEAR 1979, Geological Survey, Huron, SD. Water Resources

Div.

Available from the National Technical Information Service, Springfield, VA 22161 as PB80-195936, Price codes: A16 in paper copy, A01 in microfiche Geological Survey Water-Data Report SD-79-1, May 1980, 353 p, 6 Fig.

Descriptors: *South Dakota, *Hydrologic data, *Surface waters, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Water wells, Water levels, Data collections, Sites.

Water resources data for the 1979 water year for Water resources data for the 1979 water year for South Dakota consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of laks and reservoirs; and water levels in wells. This report contains discharge records for 109 gaging stations, stage and contents for 10 lakes and reservoirs, water quality for 22 gaging stations and 62 wells, and water levels for 16 observation wells. Also included are 797 crest-stage partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collectin program, and are published as miscellaneous meaurements and analyses. These data represent that part of the National Water Data System oprated by the U.S. Geologises. I nese data represent that part of the National Water Data System oprated by the U.S. Geological Survey and cooperating State and Federal agencies in South Dakota. (Kosco-USGS) W80-06165

WATER RESOURCES DATA FOR CALIFORNIA, WATER YEAR 1978-VOLUME 2. PACIFIC SLOPE BASINS FROM ARROYO GRANDE TO OREGON STATE LINE EXCEPT CENTRAL

VALLEY, Geological Survey, Menlo Park, CA. Water Re-

sources Div.

Available from the National Technical Information Available from the National Technical Information Service, Springfield, VA 22161 as PB80-118730, Price codes: A25 in paper copy, A01 in microfiche. Geological Survey Water-Data Report CA-78-2, September 1979. 366 p, 3 Fig. 1 Tab.

Descriptors: *California, *Hydrologic data, *Surface waters, *Groundwater, *Water quality, gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperarure, Chemical analysis, Lakes, Reservoirs, Water wells, Water levels, Data collections, Sites.

Volume 2 of water resources data for the 1978 water year for California consists of records of stage, discharge, and water quality of streams and wells; stage, contents and water quality in lakes and reservoirs, and water levels in wells. This volume contains discharge records for 166 gaging stations, stage and contents for 20 lakes and reservoirs, water quality for 134 stations and 13 wells and water levels for 17 observation wells. Also included are 15 crest-stage partial-record stations. Also included are 15 crest-stage partial-record stations. These data represent that part of the national Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in California. (Kosco-USGS)

WATER RESOURCES DATA FOR CALIFORNIA, WATER YEAR 1978--VOLUME 3. SOTHR CENTRAL VALLEY BASINS AND THE GREAT BASIN FROM WALKER RIVER TO TRUCKEE

Geological Survey, Menlo Park, CA. Water Resources Div.

sources Div.

Available from the National Technical Information
Service, Springfield, VA 22161 as PB80-155534,
Price codes: Al9 in paper copy, A01 in microfiche.
Geological Survey Water-Data Report CA-78-3,
january 1980. 429 p, 12 Fig, 1 Tab.

Descriptors: *California, *Hydrologic data, *Surface waters, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Water wells, Water levels, Data collections, Sites, Great Basin, *Walker River, *Truckee River, *Souther central

Volume 3 of water resources data for the 1978 water year for California consists of records of stage, discharge, gage-height, and water quality of streams; stage, contents, and water quality in lakes and reservoirs; and water levels in wells. This and reservoirs; and water levels in wells. This volume contains discharge records for 179 gaging stations, stage and contents for 40 lakes and reservoirs, gage-height records for 2 lakes, and water quality for 55 stations, and water levels for 22 observation wells. Also included are 34 crest-stage partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as spe-

cial investigations and miscellaneous measurerenents. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in California. (Kosco-USGS) W80-06167

WATER RESOURCES DATA FOR CALIFORNIA, WATER YEAR 1978 VOLUME 4. NORTHERN CENTRAL VALLEY BASINS AND THE GREAT BASIN FROM HONEY LAKE BASIN TO OREGON STATE LINE,

Geological Survey, Menlo Park, CA. Water Re-

Geological Survey, Menio Park, C.A. water Resources Div. Available from the National Technical Information Service, Springfield, VA 22161 as PB80-118748, Price codes: A22 in paper copy, A01 in microfiche. Geological Survey Water-Data Report CA-78-4, September 1979. 493 p, 12 Fig, 1 Tab.

Descriptors: "California, "Hydrologic data, "Surface waters, "Groundwater, "Water quality, Gaging statons, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Water wells, Water levels, Data collections, Sites, "Northern Central Valley basins(CA), "The Great Basin(CA), "Honey Lake basin(CA).

Volume 4 of the water resources data for the 1978 water year for California consists of records of stage, discharge, and water quality of streams; stage, contents, and water quality in lakes and water quality links and water quality in lakes and water quality in lakes and water quality in lakes and contents of the wells. This volume contains discharge records for 196 gaging stations, stage and contents for 34 lakes and reservoirs precipitation data for 2 stations, water quality for 81 stations, and water levels for 1 observation well. Also included are 23 stations, water quanty for 5 stations, and water levels for 1 observation well. Also included are 23 crest-stage partial-record stations, 35 low-flow par-tial-record stations, and 3 water-quality partial-record stations. Additional water data were colrecord stations. Additional water data were col-lected at various sites, not part of the systematic data-collection program, and are published as spe-cial investigations and miscellaneous measure-ments. These data represent that part of the Na-tional Water Data System operated by the U.S. Geological Survey and cooperating State and Fed-eral agencies in California. (Kosco-USGS) W80-06168

WATER RESOURCES DATA FOR LOUISIANA, WATER YEAR 1979-VOLUME 1. CENTRAL AND NORTHERN LOUISIANA. Geological Survey, Baton rouge, LA. Water Re-sources Div.

Available from the National Technical Inform Avainable from the National Technical Information Service, Springfield, VA 22161 as PB80-153299, Price codes: A19 in paper copy, A01 in microfiche. Geological Survey Water-Data Report LA-79-1, January 1980. 426 p., 9 Fig.

Descriptors: *Louisiana, *Hydrologic data, *Surface waters, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperatue, Chemical analysis, Lakes, Reservoirs, Water wells, Water levels, Data collections, Sites, *Central and northern Louisiana

Water resources data for the 1979 water year for Louisiana consist of records of stage, discharge, and water quality of streams; stage, contents, and Louisiana consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes, and reservoirs; and water levels and water quality of ground water. This report, in three volumes, contains records for water discharge at 78 gaging stations (including stage for 72 of thee stations); stage only for 42 gaging stations and 10 lakes; contents for 1 reservoir; water quality for 146 surface-water stations (including 22 gaging stations, 52 miscellaneous sites, and 24 lakes), and 335 wells; and water levels for 685 observation wells. Also included are data for 212 crest-stage and flood-profile partial-record for 212 crest-stage and flood-profile partial-record stations. Additional water data were collected at stations. Administrational water data were confected at various sites not involved in th systematic data-collection program, and are published as miscellaneous measurements. Records for a few pertinent stations in bordering States are also included in this report. These data represent that part of the national Water Data System operated by the U.S.

Group 7C-Evaluation, Processing and Publication

Geological Survey and cooperating State and Federal agencies in Louisiana. (Kosco-USGS) W80-06169

WATER RESOURCES DATA FOR LOUISIANA, WATER YEAR 1979--VOLUME 2. SOUTHERN LOUISIANA.

Geological Survey, Baton Rouge, LA. Water Re-

sources Div.

Available from the National Technical Information Service, Springfield, VA 22161 as PB80-177579, Price codes: A20 in paper copy, A01 in microfiche copy. Geological Survey, Baton Rouge, LA. Water Resources Div.

Descriptors: *Louisiana, *Hydrologic data, *Surface waters, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment Gaging stations, Streament with the Action temperature, Chemical analysis, Lakes, Reservoirs, Water wells, Water levels, Data collections, Sites, *Southern

Water resources data for the 1979 water year for Louisiana consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of ground water. This report, in three volums, contains records for water discharge at 78 gaging stations (including stage for 72 of these stations); stage only for 42 gaging stations and 10 lakes; contents for 1 reservoir; water quality for 146 surface-water stations (including 22 gaging stations, 52 miscellaneous sites, and 24 lakes), and 335 wells; and water levels for 685 observation wells. Also included are data for 212 crest-stage and flood-profile partial-record sta-tions. Additional water data were collected at various sites not involved in the systematic data-col-lection program, and are published as miscellaneous measurements. Records for a few pertinent stations in bordering States are also included in this report. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Louisiana. (Kosco-USGS) W80-06170

WATER RESOURCES DATA FOR LOIISIANA, WATER YEAR 1979--VOLUM 3. COASTAL LOUISIANA.

Geological Survey, Baton Rouge, LA. Water Resources Div.

Geological Survey Water-Data Report LA-79-3, January 1980. 284 p, 6 Fig.

Descriptors: *Louisiana, *Hydrologic data, *Surface waters, *Groundwater, *Water quality, Gagin stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Water wells, Water levels, Data collections, Sites, *Coastal Louisiana.

Water resources data for the 1979 water year for Louisiana consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of ground water. This report, in three volumes, contains records for water discharge at 78 gaging stations (including stage for 72 of these stations): stage only for 42 gaging stations and 10 lakes; contents for 1 reservoir: water quality for 146 surface-water stations (including 22 gaging stations, 52 miscellaneous sites, and 24 lakes), and 335 well; and water levels for 685 observation wells. Also included are data for 212 crest-stage and flood profile partial-record stations. Additional water data were collected at various sites not involved in the systematic datacollection program, and are published as miscella-neous measurements. Records for a few pertinent stations in bordering States are also included in this report. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Louisiana. (Kosco-USCS) W80-06171

JMI

8. ENGINEERING WORKS

8A. Structures

RADIAL PUMP SAVES ON WATER DRAW-ING, World Water, Vol 3, No 4, p 39, April, 1980. 1 Fig.

Descriptors: *Radial wells, *Induced infiltration, Design, Water yield, Feasibility studies, Conjunctive use, Artificial recharge, Storage.

A large-diameter radial well system can extract water by induced infiltration without any direct impact on the waterway. The 4-6 m-diameter well is sunk to depths of up to 65 m. Horizontal collector pipes are driven radially out from the well into the aquifer. The wide diameter of the well facilitates installation and maintenance. The design of this system should be based on a detailed hydrogeologic investigation and feasibility study in order to obtain the most economical yield. Radial wells are ideally suited for conjunctive use schemes. (Purdin-NWWA) (Purdin-NV W80-06046

WATER FROM THE WATERSKLOOF, Department of Water Affairs, Pretoria (South

Department of

Africa).
The Civil Engineer in South Africa, Vol 20, No 12 p 331 December 1978, 3 Fig.

Descriptors: *Tunnel construction, *Irrigation systems, *Irrigation engineering, *Tunnel linings, Concrete construction, Excavation, Tunnels, Tunneling, Rock mechanics, Dam construction, Civil engineering, Clays, Drilling equipment, Weirs, Hydraulic structures, *Watershed management,

Various problems were encontered during excavavarious problems were encontered during excava-tions for the tunnel system of the Theewatersklof dam. The tunnel system has four basic sections: (1) Theewaterskloof to Berg River, (2) Berg River to Eerste River, (3) Eerste River through Stellen-boschberg, and (4) branch tunnel from the main tunnel towards the Berge River Valley. Total tunnel excavations will e 513,000 cu m. A total of tunnel excavations will e 513,000 cu m. A total of 360,000 cu m of concrete will be used. Excavation on one heading in the Theewatersklof-Berg River area was held up for 38 months due to a badly faulted area. A tunnel shield had to be used for excavation in the Jonkershoek portal which is clay. This showed forward progress to 300 m in 19 months. Water diverted from the Berg River flows direct to delivery points or back to storage in the Theewaterskloof dam. Outlet works in the Jonkershoek Valley discharge water into the Kleinberg. shoek Valley discharge water into the Kleinplaas dam, creating a balancing and storage dam for the Stellenboschberg tunnel. Concrete lining of the five headings will be done simultaneously in 1980. The scheme will be completed with construction of the Assegaaibos dam and distribution system. (Seigler-IPA) W80-06073

8B. Hydraulics

DEPTH CONSTRAINTS ON THERMAL STOR-AGE WELLS, Houston Univ., TX

Houston Univ., 1A.
G. O. Morrell, and R. E. Collins.
In: 2nd Invitational Well-Testing Symposium Proceedings, October 25-27, 1978, Berkeley, California, Lawrence Berkeley Laboratory, University of California, Berkeley, p 108-111. 5 Fig, 1 Tab, 5

Descriptors: *Thermal water, *Storage, *Aquifers, *Water wells, *Depth, Electric power demand, Water temperature, Flow rates, Steam, Scaling, Pumping, Injection wells, Pressure head, Vapor pressure, Aquifer characteristics, Constraints, Equations

Equations are derived to compute curves showing the minimum depths required at different storage temperatures and flow rates to prevent steam for-

mation and associated scaling in a pumped aquifer hot water storage well. A first order estimate of the power required for the downhole pump at a given depth and storage temperature was made by great uchin and storage temperature was made by requiring that the pressure at the wellhead be greater than the vapor pressure of water. The exact constraint on depth for an aquifer storage system depends upon the specific parameters of the system depends upon the specific parameters of the well-aquifer system. Once a storage temperature and maximum flow rate have been selected the most important variables are the permeability and thickness of the formation and the value of the skin factor, S, which depends upon drilling and completion techniques. Power requirements of the downhole pump depend upon the depth, flow rate and storage temperature. Power requirements could be very small or as much as 25% of the net electric power which can be generated from the retrieved hot water. (Purdin-NWWA) W80-06025

COPPER RIVER HYDRAULICS STUDY AT MILLION DOLLAR BRIDGE, ALASKA, Geological Survey, Anchorage, AK. Water Re-

sources Div.

sources Liv.

S. H. Jones, and W. F. Barber, Jr.

Available from OFSS, Box 25425, Fed. Ctr.
Denver, CO. 80225. Paper copy \$8.25, microfiche
\$4.50. Geological Survey open-file report 80-223,
1980. 6 p, 1 Fig. 2 Plates, 1 Tab, 14 Ref.

Descriptors: *Hydraulics, *Bridge design, *Alaska, *Mathematical studies, *Hydraulic properties, Discharge(Water), Profiles, Lake beds, River beds, Water levels, Bathymetry, Velocity, Flow, *Copper River(Alaska), *Million Dollar Bridge(Alaska).

The Copper River hydraulic conditions in the vicinity of the Million-Dollar Bridge, Alaska, at the outlet to Miles Lake are described. The water discharge, lake and river bed profiles, bathymetry, velocity, and direction of flow are presented. velocity, and (Kosco-USGS) W80-06051

OPTIMUM SPILLWAY BREADTH FOR GRAV-

University of Strathclyde, Glasgow (Scotland). Dept. of Civil Engineering. For primary bibliographic entry see Field 2H. W80-06097

STABLE ALLUVIAL CANAL DESIGN, San Diego State Univ., CA. Dept. of Civil Engineering. For primary bibliographic entry see Field 2E. W80-06129

8C. Hydraulic Machinery

REGULATORY AND ENVIRONMENTAL IMPLICATIONS OF GROUND WATER HEAT

National Water Well Association, Worthington, OH.

For primary bibliographic entry see Field 6E. W80-06030

DRILL PROVIDES UNMIXED SAMPLES, For primary bibliographic entry see Field 7B. W80-06045

8E. Rock Mechanics and Geology

BOLTING THE ROOF AT DRAKENSBERG, Construction in Southern Africa, Vol 23, No 5, p 14, 15 and 17, August 1978.

Descriptors: *Underground powerplants, *Pumped storage, *Rock bolts, *Rock excavation, Tunnel construction, Underground structures, Corrosion control, Coatings, Rock mechanics, Drilling equipment, Tunneling, *Africa.

SCIENTIFIC AND TECHNICAL INFORMATION—Field 10

Specialized Information Center Services—Group 10D

The Drakensberg Pumped Storage Scheme in Natal is requiring the excavation of some of the largest underground chambers ever to be constructed in Southern Africa. The dual purpose scheme will supply electricity to the National Grid during peak demand periods and store energy during off peak periods and will pump water into the Vaal catchment area to supplement the Witwatersarand water supply. Three large chambers are being constructed measuring up to 196 m long, 16 m wide; and 46 m high. Due to this size, the mudstone-sandstone-silstone geology of the rock, and the presence of corrosive water, a double corrosion protected resin anchored bolt system was selected for roof support. Dywidag bolts of West Germay were used. The threaded bolt has a plastic sheath and the annulus between the bolt and the sheathing is pre-grouted with rapid hardening cement. The thread runs the full length of the bolt allowing the bolt to be cut and used for any length needed. The bolts are inserted into a resin that sets in about four minutes and allows full load after one hour. The bolts re generally between 4 and 7 m long. It is estimated that approximately 39,000 primary and secondary bolts will be used for the scheme. (Seigler-IPA)

agency program managed by the U.S. Geological Survey. The program is directed at improving access to existing water and water-related data. Nearly 150 organizations from the Federal, State-governmental, local-governmental, interstate, academic, private, and foreign sectors currently participate in the program. This article describes the NAWDEX program and contains descriptions of the types of data and services available from organizations participating in NAWDEX. A point of contact for obtaining data and services is provided for each organization. (Kosco-USGS)

8I. Fisheries Engineering

ESTROGEN SEX REVERSAL OF TILAPIA AUREA, Auburn Univ., AL. Dept. of Fisheries and Allied Aquacultures. K. D. Hopkins, W. L. Shelton, and C. R. Engle. Aquaculture, Vol 18, p 263-268, 1979, 2 Tab, 11 Ref OWRT B075-AL(2),1434-0001-8055.

Descriptors: *Chemical treatment, *Monosex offspring, *Tilapia aurea, Fish physiology, Fish reproductin, Fish genetics, Sex reversal(Fish), Diethylstilbestrol.

Chemical treatments were used to produce sexreversed female (genetic male) Tilaphia aurea,
which can be bred to produce monosex offspring.
Various combinations of estrogens, two synthetic
and one natural, an antiandrogen, and a 'pituitary
blocking agent' were orally administered to sexually undifferentiated fry. Treatment periods were 4,
5, 6 and 8 weeks. Seven of the 36 treatments
produced more than 50% females (alpha = 0.05.)
Two treatments were more successful than the
others: (1) 17-alpha-ethynylestradiol (EE) at 100
mg kg-1 diet in combination with methallibure
(ME) at 100 mg kg-1 for six weeks and (2) EE-100
with ME-100 and cyproterone accetae (CA) at 100
mg kg for six weeks. These treatments produced
fish that were 90% female. Comparisons of the
treatments with and without CA indicated that Ca
may lessen the hormone effectiveness of the treatments. Diethylstilbestrol was as potent as EE in
comparable CA treatments.
W80-06035

10. SCIENTIFIC AND TECHNICAL INFORMATION

10D. Specialized Information Center Services

WATER DATA AND SERVICES AVAILABLE FROM PARTICIPANTS IN THE NATIONAL WATER DATA EXCHANGE, Geologica! Survey, Reston, VA. Water Resources Div. M. D. Edwards. Water Resources Bulletin, Vol 16, No 1, p 1-14, February 1980.

Descriptors: "Hydrologic data, "Information retrieval, "Organizations, "Information exchange, Water resources, Data storage and retrieval, "National Water Data Exchange(NAWDEX), "Member organizations.

The National Water Data Exchange (NAWDEX) was implemented in January 1976 as an inter-

8 О м і

SUBJECT INDEX

ABATEMENT The Impact of Nonstructural Flood Abatement Measures on Patterns of Industrial Location,	AQUICULTUE Assessment of Sewage Lagoons as Potential Fish Culture Sites in West Central Wisconsin,	AROMATIC COMPOUNDS Sorption of Dibenzothiophene by Soils and Sediments,
W80-06011 6F	W80-06076 5D	W80-06110 5B
AERATION Flotation Pump Device, W80-06124 5G	AQUIFER CHARACTERISTICS Maps Showing Ground-Water Conditions in the Hopi Area, Coconino and Navajo Counties, Ari- zona-1977,	ATTITUDINAL SURVEYS Water Resource Preservation: Personal Values and Public Support,
AEROBIC BACTERIA	Zona-1977, W80-06052 7C	W80-06043 6B
Stratification of Aerobic Methane-Oxidizing Organisms in Lake Mendota, Madison, Wisconsin, W80-06116	Geohydrologic Data for the Lower Wood River Ground-Water Reservoir, Rhode Island, W80-06068 7C	AUSTRALIA A Frequency Distribution for Annual Floods, W80-06152 2E
AESTHETICS Water Resource Preservation: Personal Values and Public Support, W80-06043 6B	AQUIFER MANAGEMENT Management Model of a Ground Water System with a Transient Pollutant Source, W80-06015 5G	AUTOMATIC CONTROL Present Methods and Prospectives in Water Meter Reading and Billing (Methods Actuelles et Prospectives en Matiere de Releve des Comp-
AFRICA Bolting the Roof at Drakensberg,	Storage of Freshwater in Saline Aquifers, W80-06022 4B	teurs et de Facturation des Consommations d'eau), W80-06120 6B
W80-06075 8E The nature of Rainfall fluctuations in Subtropi-	Storage of Freshwater in Saline Aquifers,	AVAILABLE WATER
cal West Africa, W80-06095 2B	W80-06199 4B AQUIFER PROTECTION	Crop Production and Water Supply Characteris- tics of Kern County, W80-06082 6C
The Appropriate Technology of Promoting Safe	Regulation of Land Use Practices for Areas Surrounding Aquifers - Economic and Legal	AVALANCHES
Water Supply in Africa, W80-06119 5F	Implications, W80-06002 6E	A Recommendation for the Application of the Roch Index for Slab Avalanche Release,
AGRICULTURAL RUNOFF Irrigation Return Water Impact on Selected At-	AQUIFER RECHARGE AREAS Regulation of Land Use Practices for Areas	W80-06099 2C Forces on Structures Impacted and Enveloped
tached Diatoms in the Sacramento River, Cali- fornia, W80-06080 5C	Surrounding Aquifers - Economic and Legal Implications, W80-06002 6E	by Avalanches, W80-06101 2C
AGRICULTURE	AQUIFER SYSTEMS	Time-Series Modelling of Avalanche Activity from Meteorological Data,
Efficiency and Equity in Management of Agri- cultural Water Supplies, W80-06081 6C	Major Geochemical Processes in the Evolution of Carbonate-Aquifer Systems, W80-06031 2F	W80-06102 2C
		BACTERIA Relationships Between Heterotrophic Bacteria
ALASKA Copper River Hydraulics Study at Million Dollar Bridge, Alaska, W80-06051 8B	AQUIFERS Regulation of Land Use Practices for Areas Surrounding Aquifers - Economic and Legal Implications,	and Pollution in an Industrialized Estuary, W80-06126 5B
ALGAE	W80-06002 6E Evaluation of Induced Infiltration Between the	BASIC DATA COLLECTIONS Water-Quality Data for Canals in Eastern Broward County, Florida, 1975-78,
The Phosphorus-Chlorophyll Relationship in Roodeplaat Dam W80-06037 5C	River Skerne and the Magnesian Limestone in South East Durham,	W80-06061 7C
ALGORITHMS	W80-06020 4B	BEDFORMS Bedform Spacing and flow Resistane,
User's Guide to UIMIP and MTRX, W80-06006 7C	Depth Constraints on Thermal Storage Wells, W80-06025 8B	W80-06096 2J
AMAZON RIVER	Generalized Configuration of the Bottom of the Floridan Aquifer, Southwest Florida Water	BIOASSAY Evaluation of Mutagenicity Testing of Extracts from Processed Oil Shale,
Diurnal Rainfall Variation in Northeast Brazil, W80-06094 2B	Management District, W80-06054 7C	W80-06009 5A
ANALYTICAL TECHNIQUES Fluorescence: Absorbance Ratios-A Molecular- Weight Tracer of Dissolved Organic Matter,	Generalized Thickness of the Confining Bed Overlying The Floridan Aquifer, Southwest Florida Water Management District,	Acute Toxicity to Goldfish of Mixtures of Chloramines, Copper, and Linear Alkylate Sul- fonate,
W80-06134 5B	W80-06055 7C	W80-06042 5A
ANGIOSPERMS Nitrogen Fixation Associated with Four Species of Submerged Anglosperms in the Central	A Statistical Approach to the Inverse Problem of Aquifer Hydrology, 3. Improved Solution Method and Added Perspective,	BIOLOGICAL COMMUNITIS Irrigation Return Water Impact on Selected Attached Diatoms in the Sacramento River, California,
Chesapeake Bay, W80-06040 2I	W80-06130 2F	W80-06080 5C
ANTENNAS	Storage of Freshwater in Saline Aquifers, W80-06199 4B	BIOLOGICAL TREATMENT
Performane of V.H.F. Aerials Close To a Snow Surface,	ARIZONA	Water Quality Control and Management of Animal Wastes Through Culture with Selected
W80-06098 2C	Maps Showing Ground-Water Conditions in the Hopi Area, Coconino and Navajo Counties, Ari-	Fishes, W80-06034 5D
APPLICATION EQUIPMENT Center Pivot Construction for Center Pivot Sprinkler,	zona1977, W80-06052 7C	BIOMECHANICS Biomechanics of Vegetative Channel Linings,
W80-06173 3F	ARKANSAS RIVER BASIN Water Resources Data for Texas, Water Year	W80-06191 2E
AQUICLUDES Generalized Thickness of the Confining Bed Overlying The Floridan Aquifer, Southwest Florida Water Management District,	1978Volume 1. Arkansas River Basin, Red River Basin, Sabine River Basin, Neches River Basin, Trinity River Basin, and Intervening Coastal Basins,	BLACKNOSE DACE Delayed Behavioral Responses of the Balack- nose Dace (Rhinichthys Atratulus) to Chlora- mines and Free Chlorine,
W80-06055 7C	W80-06048 7C	W80-06039 5C

9

UMI

Solar Powered Electrodialysis - Part I: Design	Analysis of Organic Carbon in Marine Sedi-	Nitrogen Fixation Associated with Four Species
of a Solar Powered Electrodialysis System for Desalting Remote, Brackish Water Sources.	ments, W80-06133 5A	of Submerged Anglosperms in the Central Chesapeake Bay,
W80-06001 3A	CARBONATE ROCKS	W80-06040 2I
BRAZIL Diurnal Rainfall Variation in Northeast Brazil, W80-06094 2B	Effects of Karst and Geologic Structure on the Circulation of Water and Permeability in Car- bonate Aquifers, W80-06027 2F	CHLORAMINES Acute Toxicity to Goldfish of Mixtures of Chloramines, Copper, and Linear Alkylate Sulfonate.
BRAZOS RIVER BASIN		W80-06042 5A
Water Resources Data for Texas, Water Year 1978Volume 2. San Jacinto River Basin, Brazos River Basin, San Bernard River Basin,	Major Geochemical Processes in the Evolution of Carbonate-Aquifer Systems, W80-06031 2F	CHLORINATION Organic-Rich Colloidal Marerial in Estuaries
and Intervening Coastal Basins, W80-06049 7C	CARBONATES	and Its Alteration by Chlorination, W80-06093 5A
BRIDGE DESIGN	The Effect of Soil Activity on the Chemistry of Carbonate Groundwaters.	CHLORINE
Copper River Hydraulics Study at Million Dollar Bridge, Alaska,	W80-06142 2K	Delayed Behavioral Responses of the Balack- nose Dace (Rhinichthys Atratulus) to Chlora-
W80-06051 8B	Water Quality Control and Management of	mines and Free Chlorine, W80-06039 5C
BRITISH COLUMBIA Time-Series Modelling of Avalanche Activity	Animal Wastes Through Culture with Selected Fishes,	CHLOROPHYLL
from Meteorological Data, W80-06102 2C	W80-06034 5D	The Phosphorus-Chlorophyll Relationship in Roodeplaat Dam
Role of Advective Terms in Tidally Generated	CENTRAL AND NORTHERN LOUISIANA Water Resources Data for Louisiana, Water	W80-06037 5C
Residual Circulation, W80-06136 2L	Year 1979Volume 1. Central and Northern Louisiana.	The Effects of Transect Direction on Observed Spatial Patterns of Chlorophyll in Lake Tahoe,
CALIFORNIA	W80-06169 7C	W80-06135 2H
Classification of Ground-Water Recharge Poten- tial in Three Parts of Santa Cruz County, Cali- fornia,	CERIUM Determination of Cerium in Marine Sediments, W80-06086 5A	CLEVELAND (OH) Flooding Problems in A Small Urban Water- shedDoan Brook, Cleveland, Ohio,
W80-06056 4B	CESIUM	W80-06182 2E
Water Resources Data for California, Water Year 1978Volume 2. Pacific Slope Basins from Arroyo Grande to Oregon State Line Except	The Distribution of Mercury, Cesium-137, and Plutonium in an Intermittent Stream at Los Alamos,	CLIMATOLOGY Mapping Potential Evapotranspiration in Hilly Terrain,
Central Valley, W80-06166 7C	W80-06106 5B	W80-06069 2D
Water Resources Data for California, Water Year 1978Volume 3. Sothr Central Valley	CHANNEL STABILIZATION Laboratory Measurement of Sediment by Turbidity,	On Some Aspects of Climatology Associated with A Dam, W80-06071 2B
Basins and the Great Basin from Walker River to Truckee River,	W80-06127 2J	CLOUD PHYSICS
W80-06167 7C Water Resources Data for California, Water	CHANNELS Coping with the One-in-ten-years Storm,	Preliminary Cloud Microphysics Studies for Texas Hiplex 1979, W80-06072 2B
Year 1978 Volume 4. Northern Central Valley Basins and the Great Basin from Honey Lake	W80-06074 4A Laboratory Measurement of Sediment by Turbi-	CLOUDS
Basin to Oregon State Line, W80-06168 7C	dity, W80-06127 2J	Preliminary Cloud Microphysics Studies for Texas Hiplex 1979,
Downwelling over the Southern California	Stable Alluvial Canal Design,	W80-06072 2B
Shelf, W80-06184 2L	W80-06129 2E	COAL MINES The Effect of Moisture on Phosphorus Diffusion
CANALS	CHEMICAL ANALYSIS	in Coal Mine Spoils,
CANALS Water-Quality Data for Canals in Eastern Broward County, Florida, 1975-78,	Chemistry of the Spring Waters of the Ouachita Mountains Excluding Hot Springs, Arkansas,	W80-06186 5C COASTAL LOUISIANA
W80-06061 7C	W80-06010 1A Water-Quality Data for Canals in Eastern	Water Resources Data for Loiisiana, Water Year 1979Volum 3. Coastal Louisiana.
Hydrology of Jumper Creek Canal Basin, Sump- ter County, Florida,	Broward County, Florida, 1975-78, W80-06061 7C	W80-06171 7C
W80-06063 4A	CHEMICAL PRECIPITATION	COASTS Diurnal Rainfall Variation in Northeast Brazil,
Stable Alluvial Canal Design, W80-06129 2E	Water Treatment for Small Public Supplies, W80-06007 5F	W80-06094 2B
CANOPY	CHEMICAL TREATMENT	Downwelling over the Southern California Shelf,
Net Reainfall and Interception Loss in a Savan- na Cover (Netto Reenval En	Estrogen Sex Reversal of Tilapia Aurea, W80-06035 8I	W80-06184 2L
Onderskeppingsverlies In 'N Savannabedekk- ing),	CHEMISTRY OF PRECIPITATION	COCONINO COUNTY (AZ) Maps Showing Ground-Water Conditions in the
W80-06091 2I	Preliminary Cloud Microphysics Studies for Texas Hiplex 1979,	Hopi Area, Coconino and Navajo Counties, Arizona1977.
CAPILLARY FRINGE Numerical Analysis of Infiltration into a Sand	W80-06072 2B	W80-06052 7C
Profile Bounded by a Capillary Fringe, W80-06155 2G	Draft, Construction and Operation of a Sequential Rain Sampler,	COLLOIDS Organic-Rich Colloidal Marerial in Estuaries
CARASSIUS	W80-06084 7B	and Its Alteration by Chlorination,
Acute Toxicity to Goldfish of Mixtures of	Effects of Chemical Defoliation of an Abies	W80-06093 5A
Chloramines, Copper, and Linear Alkylate Sul- fonate.	Grandis Habitat on Amounts and Chemistry of Throughfall and Stemflow,	COLORADO RIVER BASIN Water Resources Data for Texas, Water Year
W80-06042 5A	W80-06105 2B	1978Volume 3. Colorado River Basin, Lavaca

River Basin, Guadalupe River Basin, Nueces River Basin, Rio Grande Basin, and Intervening	CROP PRODUCTION Efficiency and Equity in Management of Agri-	DESIGN FLOOD Effect of Tail Behavior Assumptions on Flood
Coastal Basins, W80-06050 7C	cultural Water Supplies, W80-06081 6C	Predictions, W80-06154 2E
COMMUNITY DEVELOPMENT Investigation of Groundwater Quality and Its Effect on Suburban Development in Washoe	Crop Production and Water Supply Characteris- tics of Kern County, W80-06082 6C	DESIGN STORM Erosivity Values for Individual Design Storms, W80-06195
Valley, Nevada,		DIATOMS
W80-06005 5A	CURRENTS (WATER)	Irrigation Return Water Impact on Selected At-
COMPUTER MODELS Management Model of a Ground Water System	Mixing and Circulation in the Northwestern Gulf of St. Lawrence: A Study of a Buoyancy- Driven Current System,	tached Diatoms in the Sacramento River, Cali- fornia,
with a Transient Pollutant Source,	W80-06122 2L	W80-06080 5C
W80-06015 5G A Model to Assess Migration from Shallow	DAM CONSTRUCTION On Some Aspects of Climatology Associated	The Annual Cycle of Plankton Diatom Growth and Silica Production in the Inner Oslofjord, W80-06115 2L
Land Burial Facilities, W80-06019 7C	with A Dam,	
	W80-06071 2B	DIFFUSION Experiments on Arrested Saline Wedge,
Ground Water Simulation Using a One Dimensional Flow Model,	DAMS	W80-06128 2L
W80-06044 7C	The Phosphorus-Chlorophyll Relationship in Roodeplaat Dam	The Effect of Moisture on Phosphorus Diffusion
Calibration of a Distributed Routing Rainfall-	W80-06037 5C	in Coal Mine Spoils, W80-06186 5C
Runoff Model at Four Ruban Sites Near Miami,	Optimum Spillway Breadth for Gravity Dams,	
Florida, W80-06060 2A	W80-06097 2H	Storage of Freshwater in Saline Aquifers, W80-06199 4B
A Spatially Responsive Hydrologic Model to	DARCY'S LAW	DISPERSION
Predict Erosion and Sediment Transport, W80-06159 2J	Singularities in Darcy Flow Through Porous Media,	Mass Transport: 1. A Stochastic Analysis of
	W80-06021 2F	Macroscopic Dispersion, W80-06149 2F
COMPUTER PROGRAMS User's Guide to UIMIP and MTRX,	DATA COLLECTIONS	DISSOLVED OXYGEN
W80-06006 7C	Water-Quality Data from Five Oregon Stream	Dissolved Oxygen in Intragravel Water of Three Tributaries to Redwood Creek, Humboldt
CONNECTICUT	W80-06067 7C	County, California,
Regulation of Land Use Practices for Areas Surrounding Aquifers - Economic and Legal	DECISION MAKING	W80-06066 4C
Implications, W80-06002 6E	Demonstration of an Analytic Model for Estab- lishing Water Resources Development Priorities, W80-06008 6B	DISSOLVED OXYGEN ANALYZERS Distribution of Oxygen in Marine Sediments Measured with Microelectrodes.
Water Resources Data for Connecticut, Water		W80-06117 2L
Year 1979, W80-06160 7C	DEFOLIATION EFFECTS Effects of Chemical Defoliation of an Abies	DISTRIBUTION PATTERNS Tensiometer-Controlled Medium Frequency
CONTINENTAL SHELF M2 Tidal Effects in Greater Cook Strait, New	Grandis Habitat on Amounts and Chemistry of Throughfall and Stemflow, W80-06105 2B	Topsoil Irrigation: A Technique to Improve Ag- ricultural Water Management,
Zealand, W80-06123 2L	DEICERS	W80-06070 3F
On the Hydrography of Shelf Waters Off the Centeral Texas Gulf Coast,	Occurrence of Salt and Lead in Snow Dump Sites,	A Frequency Distribution for Annual Floods W80-06152 2E
W80-06183 2L	W80-06085 5A	Diurnal Rainfall Variation in Northeast Brazil
COOK STRAIT (NZ)	DEMINERALIZATION	W80-06094 2E
M2 Tidal Effects in Greater Cook Strait, New	Refrigeration Type Water Desalinisation Units, W80-06178 3A	DIURNAL RAINFALL
Zealand, W80-06123 2L		Diurnal Rainfall Variation in Northeast Brazil
	DEPTH Depth Constraints on Thermal Storage Wells,	W80-06094 2E
COPEPODS Genetic and Physiological Adaptation of the		DOMESTIC WATER
Copepod Eurytemora Affinis to Seasonal Tem-	DESALINATION	The Incidence of Water Quality: A County Level Analysis,
peratures, W80-06038 2L	Solar Powered Electrodialysis - Part I: Design	W80-06150 5A
The Measurement of Temperature Tolerance:	of a Solar Powered Electrodialysis System for	DOWNWELLING
Verification of an Index, W80-06041 2L	W80-06001 3A	Downwelling over the Southern Californi Shelf,
COPPER	Refrigeration Type Water Desalinisation Units,	W80-06184 21
Acute Toxicity to Goldfish of Mixtures of		DRAINAGE Water Retention Measurement for Soils,
Chloramines, Copper, and Linear Alkylate Sul- fonate,	Water Treatment for Small Public Supplies,	W80-06198 20
W80-06042 5A	W80-06007 5F	DRAINAGE SYSTEMS
COPPER RIVER (ALASKA) Copper River Hydraulics Study at Million	Desalting Handbook for Planners. W80-06013 3A	Coping with the One-in-ten-years Storm, W80-06074
Dollar Bridge, Alaska,		Method of Covering Corrugated Drainag
W80-06051 8E	Process for Recovery of Chemicals from Saline Water,	Tubes, W80-06175
COST-BENEFIT ANALYSIS	W80-06176 3A	
Regulation of Land Use Practices for Areas Surrounding Aquifers - Economic and Legal		On Jacob's Approximation in Flow Throug
Implications,	Desalting Handbook for Planners.	Porous Media,
W80-06002 6E	W80-06013 3A	W80-06143

SUBJECT INDEX

DRILLING SAMPLES

JMI

DRILLING SAMPLES Drill Provides Unmixed Samples, W80-06045 7B	A Sampler for Cohesive Sediment in the Benthic Boundary Layer, W80-06132 7B	FISH Delayed Behavioral Responses of the Balack- nose Dace (Rhinichthys Atratulus) to Chlora-
		mines and Free Chlorine,
DROUGHTS The Response of Illinois Municipal Water Sys-	EROSION	W80-06039 5C
tems to a Prolonged Period of Drought,	Bedform Spacing and flow Resistane, W80-06096 2J	FISH BEHAVOIR
W80-06079 2E		Delayed Behavioral Responses of the Balack-
On the Statistical Characteristics of Drought	Erosivity Values for Individual Design Storms, W80-06195 2J	nose Dace (Rhinichthys Atratulus) to Chlora- mines and Free Chlorine,
Events,		W80-06039 5C
W80-06147 2B	EROSIVITY INDEX	
On the Definition of Droughts,	Erosivity Values for Individual Design Storms, W80-06195 2J	FISH DISEASES Microbiological Assessment of River Water
W80-06148 2B		Contamination by Fish Hatchery Effluent,
DUAL-TUBE DRILLING	ESTIMATED COSTS	W80-06083 5G
Drill Provides Unmixed Samples,	Desalting Handbook for Planners. W80-06013 3A	FISH HATCHERIES
W80-06045 7B		Microbiological Assessment of River Water
DUNES	ESTUARIES Organic-Rich Colloidal Marerial in Estuaries	Contamination by Fish Hatchery Effluent, W80-06083 5G
Bedform Spacing and flow Resistane, W80-06096 2J	and Its Alteration by Chlorination,	
W 80-00090 23	W80-06093 5A	FJORDS
EASTERN AUSTRALIA	Relationships Between Heterotrophic Bacteria	The Annual Cycle of Plankton Diatom Growth and Silica Production in the Inner Oslofjord,
A Frequency Distribution for Annual Floods, W80-06152 2E	and Pollution in an Industrialized Estuary,	W80-06115 2L
	W80-06126 5B	FLOOD CONTROL
EASTERN BROWARD COUNTY (FL) Water-Quality Data for Canals in Eastern	Experiments on Arrested Saline Wedge,	Coping with the One-in-ten-years Storm,
Broward County, Florida, 1975-78,	W80-06128 2L	W80-06074 4A
W80-06061 7C	Februaries Front Franctics and Brancastics	Optimum Spillway Breadth for Gravity Dams,
ECONOMICS	Estuarine Front Formation and Propagation, W80-06194 2L	W80-06097 2H
Efficiency and Equity in Management of Agri-		FLOOD DAMGE
cultural Water Supplies,	Sing Selection Production Light Transmission	Post-Flood Recovery and Hazard Mitigation:
W80-06081 6C	Size-Selective Predation, Light Transmission, and Oxygen Stratification: Evidence from the	Lessons From the Massachusetts Coast, Febru-
Crop Production and Water Supply Characteris-	Recent Sediments of Manipulated Lakes,	ary, 1978,
tics of Kern County,	W80-06118 2H	W80-06156 6F
W80-06082 6C	EURYTEMORA AFFINIS	FLOOD FORECASTING
EDUCATION	The Measurement of Temperature Tolerance:	Regional Florida
A Field Exercise on Ground Water Flow Using Seepage Meters and Mini-Piezometers,	Verification of an Index,	Central Florida, W80-06064 2E
W80-06014 7B	W80-06041 2L	
	EURYTEMORE AFFINIS	Effect of Tail Behavior Assumptions on Flood Predictions,
Public Attitudes Toward the Recreational Use	Genetic and Physiological Adaptation of the	W80-06154 2E
of Drinking Water Reservoirs in Massachusetts,	Copepod Eurytemora Affinis to Seasonal Tem- peratures,	
W80-06157 6B	W80-06038 2L	FLOOD FREQUENCY Regional Flood-Frequency Relations for West
ELECTRICAL PROPERTIES	EUTROPHICATION	Central Florida,
An Analysis of the In-Situ Resistivity of Sea Ice	The Phosphorus-Chlorophyll Relationship in	W80-06064 2E
in Terms of Its Microstructure, W80-06104 2C	Roodeplaat Dam	FLOOD PLAIN INSURANCE
	W80-06037 5C	Post-Flood Recovery and Hazard Mitigation:
ELECTRODIALYSIS	EVALUATION	Lessons From the Massachusetts Coast, Febru- ary, 1978,
Solar Powered Electrodialysis - Part I: Design of a Solar Powered Electrodialysis System for	Classification of Ground-Water Recharge Poten-	W80-06156 6F
Desalting Remote, Brackish Water Sources.	tial in Three Parts of Santa Cruz County, Cali- fornia.	FLOOD PLAINS
W80-06001 3A	W80-06056 4B	The Impact of Nonstructural Flood Abatement
Water Treatment for Small Public Supplies,		Measures on Patterns of Industrial Location,
W80-06007 5F	Hydrology of Jumper Creek Canal Basin, Sump- ter County, Florida,	W80-06011 6F
ENERGY BUGET	W80-06063 4A	FLOOD RECOVERY HELP
Mapping Potential Evapotranspiration in Hilly	EVAPORATION	Post-Flood Recovery and Hazard Mitigation:
Terrain, W80-06069 2D	Net Reainfall and Interception Loss in a Savan-	Lessons From the Massachusetts Coast, Febru- ary, 1978,
W 80-00009 2D	na Cover (Netto Reenval En	W80-06156 6F
ENGLAND	Onderskeppingsverlies In 'N Savannabedekk-	
Relationships Between Heterotrophic Bacteria and Pollution in an Industrialized Estuary,	ing), W80-06091 21	FLOODPLAINS Post-Flood Recovery and Hazard Mitigation:
W80-06126 5B		Lessons From the Massachusetts Coast, Febru-
ENTRAINMENT	EVAPOTRANSPIRATION Mapping Potential Evapotranspiration in Hilly	ary, 1978,
The Entrainment of Cohesive Sediments in	Terrain,	W80-06156 6F
Freshwater,	W80-06069 2D	FLOODS
W80-06187 2J	FERTILIZERS	The Impact of Nonstructural Flood Abatement Measures on Patterns of Industrial Location,
ENVIRONMENTAL EFFECTS	Nutrient and Coliform Losses inRunoff from	W80-06011 6F
Regulatory and Environmental Implications of	Fertilized and Sewage Sludge-Treated Soil, W80-06109 5B	Flood of July 5-7 1079 on the South Fact
Ground Water Heat Pumps, W80-06030 6E		Flood of July 5-7, 1978, on the South Fork Zumbro River at Rochester, Minnesota,
	FINITE ELEMENT ANALYSIS	W80-06053 2E
EQUIPMENT Flotation Pump Device,	A Spatially Responsive Hydrologic Model to Predict Erosion and Sediment Transport,	A Frequency Distribution for Annual Floods,
W80-06124 5G	W80-06159 2J	W80-06152 2E
SU-4		

Post-Flood Recovery and Hazard Mitigation: Lessons From the Massachusetts Coast, Febru-	Some Paradoxes in the History of Hydraulics, W80-06192 2A	GOLDFISH Acute Toxicity to Goldfish of Mixtures of
ary, 1978, W80-06156 6F	FLUCTUATIONS	Chloramines, Copper, and Linear Alkylate Sul- fonate,
Flooding Problems in A Small Urban Water-	On Some Aspects of Climatology Associated with A Dam,	W80-06042 5A
shedDoan Brook, Cleveland, Ohio, W80-06182 2E	W80-06071 2B	GRASSED WATERWAYS Coping with the One-in-ten-years Storm,
FLORIDA	The nature of Rainfall fluctuations in Subtropi- cal West Africa,	W80-06074 4A
Generalized Configuration of the Bottom of the	W80-06095 2B	GROUND WATER Regulation of Land Use Practices for Areas
Floridan Aquifer, Southwest Florida Water Management District, W80-06054 7C	FLUORESCENCE Fluorescence: Absorbance Ratios-A Molecular-	Surrounding Aquifers - Economic and Legal Implications,
A STATE OF THE PARTY OF THE PAR	Weight Tracer of Dissolved Organic Matter,	W80-06002 6E
Generalized Thickness of the Confining Bed Overlying The Floridan Aquifer, Southwest	W80-06134 5B	Management Model of a Ground Water System with a Transient Pollutant Source,
Florida Water Management District, W80-06055 7C	A Recommendation for the Application of the	W80-06015 5G
	Roch Index for Slab Avalanche Release,	Ground Water Pollution by Septic Tank Drain
Potential Subsurface Zones for Liquid-Waste Storage in Florida,	W80-06099 2C	Fields,
W80-06057 5E	Time-Series Modelling of Avalanche Activity from Meteorological Data,	W80-06023 5G
Water Quality of Florida Springs,	W80-06102 2C	Regulatory and Environmental Implications of Ground Water Heat Pumps,
W80-06058 1A	A Spatially Responsive Hydrologic Model to	W80-06030 6E
Calibration of a Distributed Routing Rainfall- Runoff Model at Four Ruban Sites Near Miami,	Predict Erosion and Sediment Transport, W80-06159 2J	GROUND WATER MOVEMENT A Field Exercise on Ground Water Flow Using
Florida, W80-06060 2A	FOREST WATERSHEDS	Seepage Meters and Mini-Piezometers,
	Trace Metal Budgets for a Forested Watershed	W80-06014 7E
Water-Quality Data for Canals in Eastern Broward County, Florida, 1975-78,	in the New Jersey Pine Barrens, W80-06144 5A	Regional Ground Water Flow Near a High- Level Radioactive Waste Repository,
W80-06061 7C	FORESTS	W80-06018 2F
Hydrology of Jumper Creek Canal Basin, Sumpter County, Florida,	Effects of Chemical Defoliation of an Abies Grandis Habitat on Amounts and Chemistry of	Effects of Karst and Geologic Structure on the Circulation of Water and Permeability in Car-
W80-06063 4A	Throughfall and Stemflow, W80-06105 2B	bonate Aquifers,
Regional Flood-Frequency Relations for West		
Central Florida, W80-06064 2E	FRACTURE PERMEABILITY Fluid Flow in Naturally Fractured Reservoirs, W80-06024 2F	Ground Water Simulation Using a One Dimen- sional Flow Model, W80-06044
Characterization of Organic Nitrogen in Natural		
Waters: Its Molecular Size, Protein Content, and Interactions with Heavy Metals,	FREQUENCY ANALYSIS A Frequency Distribution for Annual Floods,	GROUNDWATER Water Quality of Florida Springs,
W80-06114 2H	W80-06152 2E	W80-06058 1A
FLORIDAN AQUIFER	FRESHWATER	Efficiency and Equity in Management of Agri-
Generalized Configuration of the Bottom of the Floridan Aquifer, Southwest Florida Water	Storage of Freshwater in Saline Aquifers, W80-06022 4B	cultural Water Supplies, W80-06081 6C
Management District, W80-06054 7C	FUNCTIONAL ANALYSIS	A Statistical Approach to the Inverse Problem
Generalized Thickness of the Confining Bed	Application of Recent Results in Functional Analysis to the Problem of Wetting Fronts,	of Aquifer Hydrology, 3. Improved Solution Method and Added Perspective,
Overlying The Floridan Aquifer, Southwest Florida Water Management District,	W80-06088 2G	W80-06130 2F
W80-06055 7C	GEOCHEMISTRY Major Geochemical Processes in the Evolution	A Note on the Meaning of Storage Coefficient W80-06139
Water Quality of Florida Springs, W80-06058 1A	of Carbonate-Aquifer Systems, W80-06031 2F	The Effect of Soil Activity on the Chemistry of Carbonate Groundwaters,
FLOW	GEOLOGY	W80-06142 2K
Fluid Flow in Naturally Fractured Reservoirs, W80-06024 2F	Classification of Ground-Water Recharge Potential in Three Parts of Santa Cruz County, Cali-	On Jacob's Approximation in Flow Through Porous Media,
Some Paradoxes in the History of Hydraulics, W80-06192 2A	fornia, W80-06056 4B	W80-06143 2I
FLOW NETS	Surficial Geology of Pulaski Quadrangle, Oswego County, New York,	Mass Transport: 1. A Stochastic Analysis o Macroscopic Dispersion, W80-06149 21
Flow Net for Unsaturated Infiltration from Peri- odic Strip Sources,	W80-06062 7C	
W80-06089 2G	GEOMORPHOLOGY	Thermohaline Instability in Anisotropic Porou Media,
FLOW RESISTANCE	'Saw-Tooth' Moraines in Front of Bodalsbreen, Southern Norway,	W80-06151 21
Some Paradoxes in the History of Hydraulics, W80-06192 2A	W80-06100 2C	Water Resources Data for Connecticut, Water 1979.
FLOW RESISTANE	GLACIAL DRIFT 'Saw-Tooth' Moraines in Front of Bodalsbreen,	W80-06160 70
Bedform Spacing and flow Resistane,	Southern Norway,	Water Resources Data for Wisconsin, Water
W80-06096 2J	W80-06100 2C	Year 1979,
FLOW SYSTEM	GLACIOLOGY	W80-06161 70
Regional Ground Water Flow Near a High- Level Radioactive Waste Repository,	'Saw-Tooth' Moraines in Front of Bodalsbreen, Southern Norway,	Water Resources Data for Nebraska, Water Year 1979,
W80-06018 2F	W80-06100 2C	W80-06162 76

Water Resources Data for New York, Water Year 1979Volum 1. New York Excluding	GULF OF ST LAWRENCE Mixing and Circulation in the Northwestern	Brazos River Basin, San Bernard River Basin, and Intervening Coastal Basins,
Long Island,	Gulf of St. Lawrence: A Study of a Buoyancy-	W80-06049 7C
W80-06163 7C	Driven Current System, W80-06122 2L	Water Resources Data for Texas, Water Year
Water Resources Data for New York, Water Year 1979Volume 2. Long Island,	HEAT PUMP	1978Volume 3. Colorado River Basin, Lavaca River Basin, Guadalupe River Basin, Nueces
W80-06164 7C	Regulatory and Environmental Implications of	River Basin, Rio Grande Basin, and Intervening
Water Resources Data for South Dakota, Water	Ground Water Heat Pumps, W80-06030 6E	Coastal Basins, W80-06050 7C
Year 1979, W80-06165 7C	HEAVY METALS	Geohydrologic Data for the Lower Wood River
Water Resources Data for California, Water	Movement of Heavy Metals into a Shallow	Ground-Water Reservoir, Rhode Island,
Year 1978-Volume 2. Pacific Slope Basins from	Aquifer by Leakage from Sewage Oxidation Ponds,	W80-06068 7C
Arroyo Grande to Oregon State Line Except Central Valley,	W80-06026 5B	Water Resources Data for Connecticut, Water Year 1979,
W80-06166 7C	Environmental Contamination Through Residu-	W80-06160 7C
Water Resources Data for California, Water	al Trace Metal Dispersal from a Derelict Lead- Zinc Mine,	Water Resources Data for Wisconsin, Water
Year 1978Volume 3. Sothr Central Valley Basins and the Great Basin from Walker River	W80-06111 5B	Year 1979, W80-06161 7C
to Truckee River,	HETEROGENEITY	Water Resources Data for Nebraska, Water
W80-06167 7C	Field Heterogeneity: Some Basic Issues, W80-06137 2G	Year 1979,
Water Resources Data for California, Water Year 1978 Volume 4. Northern Central Valley		W80-06162 7C
Basins and the Great Basin from Honey Lake	HONEY LAKE BASIN (CA) Water Resources Data for California, Water	Water Resources Data for New York, Water
Basin to Oregon State Line, W80-06168 7C	Year 1978 Volume 4. Northern Central Valley	Year 1979-Volum 1. New York Excluding Long Island,
	Basins and the Great Basin from Honey Lake Basin to Oregon State Line,	W80-06163 7C
Water Resources Data for Louisiana, Water Year 1979Volume 1. Central and Northern	W80-06168 7C	Water Resources Data for New York, Water
Louisiana. W80-06169 7C	HUMBER ESTUARY (ENGLAND)	Year 1979Volume 2. Long Island, W80-06164 7C
	Relationships Between Heterotrophic Bacteria and Pollution in an Industrialized Estuary,	
Water Resources Data for Louisiana, Water Year 1979Volume 2. Southern Louisiana.	W80-06126 5B	Water Resources Data for South Dakota, Water Year 1979,
W80-06170 7C	HUMBOLDT COUNTY (CA)	W80-06165 7C
Water Resources Data for Loiisiana, Water Year	Dissolved Oxygen in Intragravel Water of Three	Water Resources Data for California, Water
1979Volum 3. Coastal Louisiana. W80-06171 7C	Tributaries to Redwood Creek, Humboldt County, California,	Year 1978Volume 2. Pacific Slope Basins from Arroyo Grande to Oregon State Line Except
GROUNDWATER POTENTIAL	W80-06066 4C	Central Valley,
Classification of Ground-Water Recharge Poten-	HYDRAULIC PROPERTIES	W80-06166 7C
tial in Three Parts of Santa Cruz County, Cali- fornia,	Copper River Hydraulics Study at Million Dollar Bridge, Alaska,	Water Resources Data for California, Water Year 1978Volume 3. Sothr Central Valley
W80-06056 4B	W80-06051 8B	Basins and the Great Basin from Walker River
Surficial Geology of Pulaski Quadrangle,	HYDRAULICS	to Truckee River, W80-06167 7C
Oswego County, New York, W80-06062 7C	Copper River Hydraulics Study at Million	
	Dollar Bridge, Alaska, W80-06051 8B	Water Resources Data for California, Water Year 1978 Volume 4. Northern Central Valley
GROUNDWATER QUALITY Investigation of Groundwater Quality and Its	HYDROELECTRIC POWER	Basins and the Great Basin from Honey Lake
Effect on Suburban Development in Washoe	Optimal Operation of Multireservoir Power Sys-	Basin to Oregon State Line, W80-06168 7C
Valley, Nevada, W80-06005 5A	tems with Stochastic Inflows, W80-06146 2E	Water Resources Data for Louisiana, Water
GROUNDWATER RECHARGE	HYDROGEOLOGY	Year 1979Volume 1. Central and Northern
Classification of Ground-Water Recharge Poten-	A Field Exercise on Ground Water Flow Using	Louisiana. W80-06169 7C
tial in Three Parts of Santa Cruz County, Cali- fornia,	Seepage Meters and Mini-Piezometers, W80-06014 7B	Water Resources Data for Louisiana, Water
W80-06056 4B	Geohydrologic Data for the Lower Wood River	Year 1979Volume 2. Southern Louisiana.
GROUNDWATER RESOURCES	Ground-Water Reservoir, Rhode Island,	W80-06170 7C
Maps Showing Ground-Water Conditions in the Hopi Area, Coconino and Navajo Counties, Ari-	W80-06068 7C	Water Resources Data for Loiisiana, Water Year 1979Volum 3. Coastal Louisiana.
zona1977,	HYDROGRAPHY	W80-06171 7C
W80-06052 7C	On the Hydrography of Shelf Waters Off the Centeral Texas Gulf Coast,	HYDROLOGY
Geohydrologic Data for the Lower Wood River Ground-Water Reservoir, Rhode Island.	W80-06183 2L	Hydrology of Jumper Creek Canal Basin, Sump-
W80-06068 7C	HYDROLOGIC DATA	ter County, Florida, W80-06063 4A
GUADALUPE RIVER BASIN	Water Data and Services Available from Partici- pants in the National Water Data Exchange,	Runoff Synthesis Using Landsat and SCS
Water Resources Data for Texas, Water Year 1978Volume 3. Colorado River Basin, Lavaca	W80-06047 10D	Model,
River Basin, Guadalupe River Basin, Nueces	Water Resources Data for Texas, Water Year	W80-06131 2E
River Basin, Rio Grande Basin, and Intervening Coastal Basins,	1978Volume 1. Arkansas River Basin, Red River Basin, Sabine River Basin, Neches River	ICE Performane of V.H.F. Aerials Close To a Snow
W80-06050 7C	Basin, Trinity River Basin, and Intervening	Surface,
GULD OF MEXICO	Coastal Basins, W80-06048 7C	W80-06098 2C
On the Hydrography of Shelf Waters Off the		An Analysis of the In-Situ Resistivity of Sea Ice
Centeral Texas Gulf Coast, W80-06183 2L	Water Resources Data for Texas, Water Year 1978-Volume 2. San Jacinto River Basin,	in Terms of Its Microstructure, W80-06104 2C

		THE PART OF THE PA
ILLINOIS	INLETS (WATERWAYS)	IRRIGATION PRACTICES
The Response of Illinois Municipal Water Sys-	Role of Advective Terms in Tidally Generated	Tensiometer-Controlled Medium Frequency
tems to a Prolonged Period of Drought,	Residual Circulation,	Topsoil Irrigation: A Technique to Improve Ag-
W80-06079 2E	W80-06136 2L	ricultural Water Management,
		W80-06070 3F
IN-SITU RESISTIVITY	INSTRUMENTATION	
An Analysis of the In-Situ Resistivity of Sea Ice	A Field Exercise on Ground Water Flow Using	IRRIGATION SYSTEMS
in Terms of Its Microstructure,	Seepage Meters and Mini-Piezometers,	New Irrigation System Design for Maximizing
W80-06104 2C	W80-06014 7B	Irrigation Efficiency and Increasing Rainfall Uti-
		lization.
INCOME DISTRIBUTION	Performane of V.H.F. Aerials Close To a Snow	W80-06003 3F
The Incidence of Water Quality: A County	Surface,	***************************************
Level Analysis,	W80-06098 2C	Water from the Waterskloof,
W80-06150 5A		W80-06073 8A
***************************************	Present Methods and Prospectives in Water	***************************************
INDEXING	Meter Reading and Billing (Methodes Actuelles	Center Pivot Construction for Center Pivot
Demonstration of an Analytic Model for Estab-	et Prospectives en Matiere de Releve des Comp-	Sprinkler,
lishing Water Resources Development Priorities,	teurs et de Facturation des Consommations	W80-06173 3F
W80-06008 6B	d'eau),	W 00-00173
11 00 00000	W80-06120 6B	Self-Propelling Watering Apparatus,
INDIA	The second secon	W80-06177 3F
Determination of Cerium in Marine Sediments,	Optimum Management of Water Meters: Ways	
W80-06086 5A	and Means,	IRRIGATION WATER
11 00-0000	W80-06121 6B	Irrigation Return Water Impact on Selected At-
INDUCED INFILTRATION		tached Diatoms in the Sacramento River, Cali-
Evaluation of Induced Infiltration Between the	Laboratory Measurement of Sediment by Turbi-	fornia.
River Skerne and the Magnesian Limestone in	dity,	W80-06080 5C
South East Durham,	W80-06127 2J	W 00-00000 3C
		ISRAEL
W80-06020 4B	INTERCEPTION	Movement of Heavy Metals into a Shallow
Radial Pump Saves on Water Drawing,	Net Reainfall and Interception Loss in a Savan-	
	na Cover (Netto Reenval En	Aquifer by Leakage from Sewage Oxidation
W80-06046 8A	Onderskeppingsverlies In 'N Savannabedekk-	Ponds,
INDUSTRIAL WASTES	ing),	W80-06026 5B
	W80-06091 2I	THE COURSE CONTRACTOR (CT.)
Removal of Color from Paper Mill Waste		JUMPER CREEK CANAL BASIN (FL).
Waters,	Effects of Chemical Defoliation of an Abies	*SUMTER COUNTY (FL)
W80-06017 5D	Grandis Habitat on Amounts and Chemistry of	Hydrology of Jumper Creek Canal Basin, Sump-
	Throughfall and Stemflow,	ter County, Florida,
Removal of Cyanide from Waste Water,	W80-06105 2B	W80-06063 4A
W80-06029 5D	W 80-00103	
Data and Andrews Brooked Problem	INTERMITTENT STREAMS	KARST HYDROLOGY
Polymer to Agglomerate Resolved Emulsions,	The Distribution of Mercury, Cesium-137, and	Effects of Karst and Geologic Structure on the
W80-06065 5D	Plutonium in an Intermittent Stream at Los	Circulation of Water and Permeability in Car-
D. 1. C. D. 16 - 1 67 1- 14-	Alamos,	bonate Aquifers,
Device for Purification of Liquids,	W80-06106 5B	W80-06027 2F
W80-06172 5D	W 80-00100 3B	11 00-00027
ENTRECOMPETE	ION EXCHANGE	KERN COUNTY (CA)
INDUSTRIES	Research on Novel Solvent Extraction Systems	Crop Production and Water Supply Characteris-
The Impact of Nonstructural Flood Abatement		tics of Kern County,
Measures on Patterns of Industrial Location,	for Industrial Water Reuse.	
W80-06011 6F	W80-06032 5D	W80-06082 6C
	ION TRANSPORT	LABORATORY TESTS
INFILTRATION		Potential for Changing Phytoplankton Growth
Urbanization-Induced Impacts on Infiltration	Industrial Water Reuse with Coupled Transport	
Capacity and on Rainfall-Runoff Relation in an	Membranes.	in Lake Powell Due to Oil Shale Development,
Hawaiian Urban Area,	W80-06033 5D	W80-06092 5B
W80-06078 4C	IDON DACTEDIA	District of Communication States
	IRON BACTERIA A Layman's Guide to Iron Bacteria Problems in	Distribution of Oxygen in Marine Sediments
Flow Net for Unsaturated Infiltration from Peri-		
		Measured with Microelectrodes,
odic Strip Sources,	Wells,	W80-06117 2L
odic Strip Sources, W80-06089 2G		W80-06117 2L
	Wells, W80-06016 5C	W80-06117 2L Water Retention Measurement for Soils,
	Wells, W80-06016 5C IRRIGATION	W80-06117 2L
W80-06089 2G	Wells, W80-06016 5C IRRIGATION Crop Production and Water Supply Characteris-	W80-06117 2L Water Retention Measurement for Soils, W80-06198 2G
W80-06089 2G Seepage Vs. Terrace Density in Reclaimed Min- eland Soil,	Wells, W80-06016 5C IRRIGATION Crop Production and Water Supply Characteristics of Kern County,	W80-06117 2L Water Retention Measurement for Soils, W80-06198 2G LAKE APOPKA (FL)
W80-06089 2G Seepage Vs. Terrace Density in Reclaimed Min-	Wells, W80-06016 5C IRRIGATION Crop Production and Water Supply Characteris-	W80-06117 2L Water Retention Measurement for Soils, W80-06198 2G LAKE APOPKA (FL) Characterization of Organic Nitrogen in Natural
W80-06089 2G Seepage Vs. Terrace Density in Reclaimed Mineland Soil, W80-06107 2G	Wells, W80-06016 5C IRRIGATION Crop Production and Water Supply Characteristics of Kern County, W80-06082 6C	W80-06117 2L Water Retention Measurement for Soils, W80-06198 2G LAKE APOPKA (FL)
W80-06089 2G Seepage Vs. Terrace Density in Reclaimed Mineland Soil, W80-06107 2G Numerical Analysis of Infiltration into a Sand	Wells, W80-06016 IRRIGATION Crop Production and Water Supply Characteristics of Kern County, W80-06082 OC Nutrients and Associated Ion Concentrations in	W80-06117 2L Water Retention Measurement for Soils, W80-06198 2G LAKE APOPKA (FL) Characterization of Organic Nitrogen in Natural Waters: Its Molecular Size, Protein Content, and
W80-06089 2G Seepage Vs. Terrace Density in Reclaimed Mineland Soil, W80-06107 2G Numerical Analysis of Infiltration into a Sand Profile Bounded by a Capillary Fringe,	Wells, W80-06016 5C IRRIGATION Crop Production and Water Supply Characteristics of Kern County, W80-06082 6C	W80-06117 Water Retention Measurement for Soils, W80-06198 2G LAKE APOPKA (FL) Characterization of Organic Nitrogen in Natural Waters: Its Molecular Size, Protein Content, and Interactions with Heavy Metals,
W80-06089 2G Seepage Vs. Terrace Density in Reclaimed Mineland Soil, W80-06107 2G Numerical Analysis of Infiltration into a Sand	Wells, W80-06016 5C IRRIGATION Crop Production and Water Supply Characteristics of Kern County, W80-06082 6C Nutrients and Associated Ion Concentrations in Irrigation Return Flow From Flooded Rice Fields,	W80-06117 2L Water Retention Measurement for Soils, W80-06198 2G LAKE APOPKA (FL) Characterization of Organic Nitrogen in Natural Waters: Its Molecular Size, Protein Content, and
W80-06089 2G Seepage Vs. Terrace Density in Reclaimed Mineland Soil, W80-06107 2G Numerical Analysis of Infiltration into a Sand Profile Bounded by a Capillary Fringe, W80-06155 2G	Wells, W80-06016 5C IRRIGATION Crop Production and Water Supply Characteristics of Kern County, W80-06082 6C Nutrients and Associated Ion Concentrations in Irrigation Return Flow From Flooded Rice	W80-06117 2L Water Retention Measurement for Soils, W80-06198 2G LAKE APOPKA (FL) Characterization of Organic Nitrogen in Natural Waters: Its Molecular Size, Protein Content, and Interactions with Heavy Metals, W80-06114 2H
W80-06089 2G Seepage Vs. Terrace Density in Reclaimed Mineland Soil, W80-06107 2G Numerical Analysis of Infiltration into a Sand Profile Bounded by a Capillary Fringe, W80-06155 2G Analytical-Numerical Computation of Infiltra-	Wells, W80-06016 5C IRRIGATION Crop Production and Water Supply Characteristics of Kern County, W80-06082 6C Nutrients and Associated Ion Concentrations in Irrigation Return Flow From Flooded Rice Fields, W80-06108 5B	W80-06117 2L Water Retention Measurement for Soils, W80-06198 2G LAKE APOPKA (FL) Characterization of Organic Nitrogen in Natural Waters: Its Molecular Size, Protein Content, and Interactions with Heavy Metals, W80-06114 2H LAKE MENDOTA (WD
W80-06089 Seepage Vs. Terrace Density in Reclaimed Mineland Soil, W80-06107 2G Numerical Analysis of Infiltration into a Sand Profile Bounded by a Capillary Fringe, W80-06155 2G Analytical-Numerical Computation of Infiltration,	Wells, W80-06016 5C IRRIGATION Crop Production and Water Supply Characteristics of Kern County, W80-06082 6C Nutrients and Associated Ion Concentrations in Irrigation Return Flow From Flooded Rice Fields, W80-06108 5B Center Pivot Construction for Center Pivot	W80-06117 Water Retention Measurement for Soils, W80-06198 LAKE APOPKA (FL) Characterization of Organic Nitrogen in Natural Waters: Its Molecular Size, Protein Content, and Interactions with Heavy Metals, W80-06114 LAKE MENDOTA (WI) Windpower Time Seris Above a Temperate
W80-06089 2G Seepage Vs. Terrace Density in Reclaimed Mineland Soil, W80-06107 2G Numerical Analysis of Infiltration into a Sand Profile Bounded by a Capillary Fringe, W80-06155 2G Analytical-Numerical Computation of Infiltra-	Wells, W80-06016 5C IRRIGATION Crop Production and Water Supply Characteristics of Kern County, W80-06082 6C Nutrients and Associated Ion Concentrations in Irrigation Return Flow From Flooded Rice Fields, W80-06108 5B Center Pivot Construction for Center Pivot Sprinkler,	W80-06117 Water Retention Measurement for Soils, W80-06198 LAKE APOPKA (FL) Characterization of Organic Nitrogen in Natural Waters: Its Molecular Size, Protein Content, and Interactions with Heavy Metals, W80-06114 LAKE MENDOTA (WI) Windpower Time Seris Above a Temperate Lake,
W80-06089 2G Seepage Vs. Terrace Density in Reclaimed Mineland Soil, W80-06107 2G Numerical Analysis of Infiltration into a Sand Profile Bounded by a Capillary Fringe, W80-06155 2G Analytical-Numerical Computation of Infiltration, W80-06196 2G	Wells, W80-06016 5C IRRIGATION Crop Production and Water Supply Characteristics of Kern County, W80-06082 6C Nutrients and Associated Ion Concentrations in Irrigation Return Flow From Flooded Rice Fields, W80-06108 5B Center Pivot Construction for Center Pivot	W80-06117 Water Retention Measurement for Soils, W80-06198 LAKE APOPKA (FL) Characterization of Organic Nitrogen in Natural Waters: Its Molecular Size, Protein Content, and Interactions with Heavy Metals, W80-06114 LAKE MENDOTA (WI) Windpower Time Seris Above a Temperate
W80-06089 2G Seepage Vs. Terrace Density in Reclaimed Mineland Soil, W80-06107 2G Numerical Analysis of Infiltration into a Sand Profile Bounded by a Capillary Fringe, W80-06155 2G Analytical-Numerical Computation of Infiltration, W80-06196 2G INFLOW	Wells, W80-06016 IRRIGATION Crop Production and Water Supply Characteristics of Kern County, W80-06082 Nutrients and Associated Ion Concentrations in Irrigation Return Flow From Flooded Rice Fields, W80-06108 5B Center Pivot Construction for Center Pivot Sprinkler, W80-06173 3F	W80-06117 Water Retention Measurement for Soils, W80-06198 LAKE APOPKA (FL) Characterization of Organic Nitrogen in Natural Waters: Its Molecular Size, Protein Content, and Interactions with Heavy Metals, W80-06114 LAKE MENDOTA (WI) Windpower Time Seris Above a Temperate Lake, W80-06112 2H
W80-06089 2G Seepage Vs. Terrace Density in Reclaimed Mineland Soil, W80-06107 2G Numerical Analysis of Infiltration into a Sand Profile Bounded by a Capillary Fringe, W80-06155 2G Analytical-Numerical Computation of Infiltration, W80-06196 2G INFLOW On Some Aspects of Climatology Associated	Wells, W80-06016 5C IRRIGATION Crop Production and Water Supply Characteristics of Kern County, W80-06082 6C Nutrients and Associated Ion Concentrations in Irrigation Return Flow From Flooded Rice Fields, W80-06108 5B Center Pivot Construction for Center Pivot Sprinkler, W80-06173 3F Water Sprinkler,	W80-06117 Water Retention Measurement for Soils, W80-06198 LAKE APOPKA (FL) Characterization of Organic Nitrogen in Natural Waters: Its Molecular Size, Protein Content, and Interactions with Heavy Metals, W80-06114 LAKE MENDOTA (WD) Windpower Time Seris Above a Temperate Lake, W80-06112 Stratification of Aerobic Methane-Oxidizing Or-
W80-06089 2G Seepage Vs. Terrace Density in Reclaimed Mineland Soil, W80-06107 2G Numerical Analysis of Infiltration into a Sand Profile Bounded by a Capillary Fringe, W80-06155 2G Analytical-Numerical Computation of Infiltration, W80-06196 2G INFLOW On Some Aspects of Climatology Associated with A Dam,	Wells, W80-06016 IRRIGATION Crop Production and Water Supply Characteristics of Kern County, W80-06082 Nutrients and Associated Ion Concentrations in Irrigation Return Flow From Flooded Rice Fields, W80-06108 5B Center Pivot Construction for Center Pivot Sprinkler, W80-06173 3F	W80-06117 Water Retention Measurement for Soils, W80-06198 LAKE APOPKA (FL) Characterization of Organic Nitrogen in Natural Waters: Its Molecular Size, Protein Content, and Interactions with Heavy Metals, W80-06114 LAKE MENDOTA (WI) Windpower Time Seris Above a Temperate Lake, W80-06112 2H Stratification of Aerobic Methane-Oxidizing Organisms in Lake Mendota, Madison, Wisconsin,
W80-06089 2G Seepage Vs. Terrace Density in Reclaimed Mineland Soil, W80-06107 2G Numerical Analysis of Infiltration into a Sand Profile Bounded by a Capillary Fringe, W80-06155 2G Analytical-Numerical Computation of Infiltration, W80-06196 2G INFLOW On Some Aspects of Climatology Associated	Wells, W80-06016 5C IRRIGATION Crop Production and Water Supply Characteristics of Kern County, W80-06082 6C Nutrients and Associated Ion Concentrations in Irrigation Return Flow From Flooded Rice Fields, W80-06108 5B Center Pivot Construction for Center Pivot Sprinkler, W80-06173 3F Water Sprinkler, W80-06174 3F	W80-06117 Water Retention Measurement for Soils, W80-06198 LAKE APOPKA (FL) Characterization of Organic Nitrogen in Natural Waters: Its Molecular Size, Protein Content, and Interactions with Heavy Metals, W80-06114 LAKE MENDOTA (WD) Windpower Time Seris Above a Temperate Lake, W80-06112 Stratification of Aerobic Methane-Oxidizing Or-
W80-06089 2G Seepage Vs. Terrace Density in Reclaimed Mineland Soil, W80-06107 2G Numerical Analysis of Infiltration into a Sand Profile Bounded by a Capillary Fringe, W80-06155 2G Analytical-Numerical Computation of Infiltration, W80-06196 2G INFLOW On Some Aspects of Climatology Associated with A Dam, W80-06071 2B	Wells, W80-06016 5C IRRIGATION Crop Production and Water Supply Characteristics of Kern County, W80-06082 6C Nutrients and Associated Ion Concentrations in Irrigation Return Flow From Flooded Rice Fields, W80-06108 5B Center Pivot Construction for Center Pivot Sprinkler, W80-06173 3F Water Sprinkler, W80-06174 3F Method of Covering Corrugated Drainage	W80-06117 Water Retention Measurement for Soils, W80-06198 LAKE APOPKA (FL) Characterization of Organic Nitrogen in Natural Waters: Its Molecular Size, Protein Content, and Interactions with Heavy Metals, W80-06114 LAKE MENDOTA (WI) Windpower Time Seris Above a Temperate Lake, W80-06112 Stratification of Aerobic Methane-Oxidizing Organisms in Lake Mendota, Madison, Wisconsin, W80-06116 2H
W80-06089 2G Seepage Vs. Terrace Density in Reclaimed Mineland Soil, W80-06107 2G Numerical Analysis of Infiltration into a Sand Profile Bounded by a Capillary Fringe, W80-06155 2G Analytical-Numerical Computation of Infiltration, W80-06196 2G INFLOW On Some Aspects of Climatology Associated with A Dam, W80-06071 2B INFORMATION EXCHANGE	Wells, W80-06016 IRRIGATION Crop Production and Water Supply Characteristics of Kern County, W80-06082 Nutrients and Associated Ion Concentrations in Irrigation Return Flow From Flooded Rice Fields, W80-06108 Center Pivot Construction for Center Pivot Sprinkler, W80-06173 Water Sprinkler, W80-06174 3F Method of Covering Corrugated Drainage Tubes,	W80-06117 Water Retention Measurement for Soils, W80-06198 LAKE APOPKA (FL) Characterization of Organic Nitrogen in Natural Waters: Its Molecular Size, Protein Content, and Interactions with Heavy Metals, W80-06114 LAKE MENDOTA (WI) Windpower Time Seris Above a Temperate Lake, W80-06112 Stratification of Aerobic Methane-Oxidizing Organisms in Lake Mendota, Madison, Wisconsin, W80-06116 LAKE MICHIGAN
W80-06089 Seepage Vs. Terrace Density in Reclaimed Mineland Soil, W80-06107 2G Numerical Analysis of Infiltration into a Sand Profile Bounded by a Capillary Fringe, W80-06155 2G Analytical-Numerical Computation of Infiltration, W80-06196 2G INFLOW On Some Aspects of Climatology Associated with A Dam, W80-06071 2B INFORMATION EXCHANGE Water Data and Services Available from Partici-	Wells, W80-06016 5C IRRIGATION Crop Production and Water Supply Characteristics of Kern County, W80-06082 6C Nutrients and Associated Ion Concentrations in Irrigation Return Flow From Flooded Rice Fields, W80-06108 5B Center Pivot Construction for Center Pivot Sprinkler, W80-06173 3F Water Sprinkler, W80-06174 3F Method of Covering Corrugated Drainage	W80-06117 Water Retention Measurement for Soils, W80-06198 LAKE APOPKA (FL) Characterization of Organic Nitrogen in Natural Waters: Its Molecular Size, Protein Content, and Interactions with Heavy Metals, W80-06114 LAKE MENDOTA (WI) Windpower Time Seris Above a Temperate Lake, W80-06112 Stratification of Aerobic Methane-Oxidizing Organisms in Lake Mendota, Madison, Wisconsin, W80-06116 LAKE MICHIGAN Occurrence of A Deep Nitrite Maximum in
W80-06089 Seepage Vs. Terrace Density in Reclaimed Mineland Soil, W80-06107 2G Numerical Analysis of Infiltration into a Sand Profile Bounded by a Capillary Fringe, W80-06155 2G Analytical-Numerical Computation of Infiltration, W80-06196 2G INFLOW On Some Aspects of Climatology Associated with A Dam, W80-06071 2B INFORMATION EXCHANGE Water Data and Services Available from Participants in the National Water Data Exchange,	Wells, W80-06016 5C IRRIGATION Crop Production and Water Supply Characteristics of Kern County, W80-06082 6C Nutrients and Associated Ion Concentrations in Irrigation Return Flow From Flooded Rice Fields, W80-06108 5B Center Pivot Construction for Center Pivot Sprinkler, W80-06173 3F Water Sprinkler, W80-06174 3F Method of Covering Corrugated Drainage Tubes, W80-06175 3F	W80-06117 Water Retention Measurement for Soils, W80-06198 LAKE APOPKA (FL) Characterization of Organic Nitrogen in Natural Waters: Its Molecular Size, Protein Content, and Interactions with Heavy Metals, W80-06114 LAKE MENDOTA (WI) Windpower Time Seris Above a Temperate Lake, W80-06112 Stratification of Aerobic Methane-Oxidizing Organisms in Lake Mendota, Madison, Wisconsin, W80-06116 LAKE MICHIGAN Occurrence of A Deep Nitrite Maximum in Lake Michigan,
W80-06089 Seepage Vs. Terrace Density in Reclaimed Mineland Soil, W80-06107 2G Numerical Analysis of Infiltration into a Sand Profile Bounded by a Capillary Fringe, W80-06155 2G Analytical-Numerical Computation of Infiltration, W80-06196 2G INFLOW On Some Aspects of Climatology Associated with A Dam, W80-06071 2B INFORMATION EXCHANGE Water Data and Services Available from Partici-	Wells, W80-06016 IRRIGATION Crop Production and Water Supply Characteristics of Kern County, W80-06082 Nutrients and Associated Ion Concentrations in Irrigation Return Flow From Flooded Rice Fields, W80-06108 Center Pivot Construction for Center Pivot Sprinkler, W80-06173 Water Sprinkler, W80-06174 Method of Covering Corrugated Drainage Tubes, W80-06175 Self-Propelling Watering Apparatus,	W80-06117 Water Retention Measurement for Soils, W80-06198 LAKE APOPKA (FL) Characterization of Organic Nitrogen in Natural Waters: Its Molecular Size, Protein Content, and Interactions with Heavy Metals, W80-06114 LAKE MENDOTA (WI) Windpower Time Seris Above a Temperate Lake, W80-06112 Stratification of Aerobic Methane-Oxidizing Organisms in Lake Mendota, Madison, Wisconsin, W80-06116 LAKE MICHIGAN Occurrence of A Deep Nitrite Maximum in
W80-06089 2G Seepage Vs. Terrace Density in Reclaimed Mineland Soil, W80-06107 2G Numerical Analysis of Infiltration into a Sand Profile Bounded by a Capillary Fringe, W80-06155 2G Analytical-Numerical Computation of Infiltration, W80-06196 2G INFLOW On Some Aspects of Climatology Associated with A Dam, W80-06071 2B INFORMATION EXCHANGE Water Data and Services Available from Participants in the National Water Data Exchange, W80-06047 10D	Wells, W80-06016 5C IRRIGATION Crop Production and Water Supply Characteristics of Kern County, W80-06082 6C Nutrients and Associated Ion Concentrations in Irrigation Return Flow From Flooded Rice Fields, W80-06108 5B Center Pivot Construction for Center Pivot Sprinkler, W80-06173 3F Water Sprinkler, W80-06174 3F Method of Covering Corrugated Drainage Tubes, W80-06175 3F	W80-06117 Water Retention Measurement for Soils, W80-06198 LAKE APOPKA (FL) Characterization of Organic Nitrogen in Natural Waters: Its Molecular Size, Protein Content, and Interactions with Heavy Metals, W80-06114 LAKE MENDOTA (WI) Windpower Time Seris Above a Temperate Lake, W80-06112 Stratification of Aerobic Methane-Oxidizing Organisms in Lake Mendota, Madison, Wisconsin, W80-06116 LAKE MICHIGAN Occurrence of A Deep Nitrite Maximum in Lake Michigan, W80-06189 2H
W80-06089 Seepage Vs. Terrace Density in Reclaimed Mineland Soil, W80-06107 2G Numerical Analysis of Infiltration into a Sand Profile Bounded by a Capillary Fringe, W80-06155 2G Analytical-Numerical Computation of Infiltration, W80-06196 2G INFLOW On Some Aspects of Climatology Associated with A Dam, W80-06071 2B INFORMATION EXCHANGE Water Data and Services Available from Participants in the National Water Data Exchange, W80-06047 INFORMATION RETRIEVAL	Wells, W80-06016 5C IRRIGATION Crop Production and Water Supply Characteristics of Kern County, W80-06082 6C Nutrients and Associated Ion Concentrations in Irrigation Return Flow From Flooded Rice Fields, W80-06108 5B Center Pivot Construction for Center Pivot Sprinkler, W80-06173 3F Water Sprinkler, W80-06174 3F Method of Covering Corrugated Drainage Tubes, W80-06175 3F Self-Propelling Watering Apparatus, W80-06177 3F	W80-06117 Water Retention Measurement for Soils, W80-06198 LAKE APOPKA (FL) Characterization of Organic Nitrogen in Natural Waters: Its Molecular Size, Protein Content, and Interactions with Heavy Metals, W80-06114 LAKE MENDOTA (WI) Windpower Time Seris Above a Temperate Lake, W80-06112 Stratification of Aerobic Methane-Oxidizing Organisms in Lake Mendota, Madison, Wisconsin, W80-06116 LAKE MICHIGAN Occurrence of A Deep Nitrite Maximum in Lake Michigan, W80-06189 LAKE ONTARIO
W80-06089 Seepage Vs. Terrace Density in Reclaimed Mineland Soil, W80-06107 2G Numerical Analysis of Infiltration into a Sand Profile Bounded by a Capillary Fringe, W80-06155 2G Analytical-Numerical Computation of Infiltration, W80-06196 2G INFLOW On Some Aspects of Climatology Associated with A Dam, W80-06071 2B INFORMATION EXCHANGE Water Data and Services Available from Participants in the National Water Data Exchange, W80-06047 INFORMATION RETRIEVAL Water Data and Services Available from Participants	Wells, W80-06016 IRRIGATION Crop Production and Water Supply Characteristics of Kern County, W80-06082 Nutrients and Associated Ion Concentrations in Irrigation Return Flow From Flooded Rice Fields, W80-06108 Center Pivot Construction for Center Pivot Sprinkler, W80-06173 Water Sprinkler, W80-06174 Method of Covering Corrugated Drainage Tubes, W80-06175 Self-Propelling Watering Apparatus, W80-06177 JRRIGATION ENGINEERING	W80-06117 Water Retention Measurement for Soils, W80-06198 LAKE APOPKA (FL) Characterization of Organic Nitrogen in Natural Waters: Its Molecular Size, Protein Content, and Interactions with Heavy Metals, W80-06114 LAKE MENDOTA (WI) Windpower Time Seris Above a Temperate Lake, W80-06112 2H Stratification of Aerobic Methane-Oxidizing Organisms in Lake Mendota, Madison, Wisconsin, W80-06116 LAKE MICHIGAN Occurrence of A Deep Nitrite Maximum in Lake Michigan, W80-06189 2H LAKE ONTARIO Mean Summer Circulation in Lake Ontario
W80-06089 Seepage Vs. Terrace Density in Reclaimed Mineland Soil, W80-06107 2G Numerical Analysis of Infiltration into a Sand Profile Bounded by a Capillary Fringe, W80-06155 2G Analytical-Numerical Computation of Infiltration, W80-06196 2G INFLOW On Some Aspects of Climatology Associated with A Dam, W80-06071 2B INFORMATION EXCHANGE Water Data and Services Available from Participants in the National Water Data Exchange, W80-06047 INFORMATION RETRIEVAL	Wells, W80-06016 5C IRRIGATION Crop Production and Water Supply Characteristics of Kern County, W80-06082 6C Nutrients and Associated Ion Concentrations in Irrigation Return Flow From Flooded Rice Fields, W80-06108 5B Center Pivot Construction for Center Pivot Sprinkler, W80-06173 3F Water Sprinkler, W80-06174 3F Method of Covering Corrugated Drainage Tubes, W80-06175 3F Self-Propelling Watering Apparatus, W80-06177 3F	W80-06117 Water Retention Measurement for Soils, W80-06198 LAKE APOPKA (FL) Characterization of Organic Nitrogen in Natural Waters: Its Molecular Size, Protein Content, and Interactions with Heavy Metals, W80-06114 LAKE MENDOTA (WI) Windpower Time Seris Above a Temperate Lake, W80-06112 Stratification of Aerobic Methane-Oxidizing Organisms in Lake Mendota, Madison, Wisconsin, W80-06116 LAKE MICHIGAN Occurrence of A Deep Nitrite Maximum in Lake Michigan, W80-06189 LAKE ONTARIO

LAKE POWELL (UT)

LAKE POWELL (UT)	LINEAR ALKYLATE SULFONATES	MASSET INLET
Potential for Changing Phytoplankton Growth in Lake Powell Due to Oil Shale Development,	Acute Toxicity to Goldfish of Mixtures of Chloramines, Copper, and Linear Alkylate Sul-	Role of Advective Terms in Tidally Generated Residual Circulation,
W80-06092 5B	fonate,	W80-06136 2L
LAKE SEDIMENTS	W80-06042 5A	MATHEMATICAL MODELS
Fractionation of Sediment Oxygen Demand,	LINEAR PROGRAMMING	Efficiency and Equity in Management of Agri-
W80-06125 5A	User's Guide to UIMIP and MTRX, W80-06006 7C	cultural Water Supplies, W80-06081 6C
The Entrainment of Cohesive Sediments in	LIQUID WASTES	Application of Recent Results in Functional
Freshwater, W80-06187 2J	Potential Subsurface Zones for Liquid-Waste Storage in Florida,	Analysis to the Problem of Wetting Fronts, W80-06088
LAKE TAHOE (CA NV)	W80-06057 5E	
The Effects of Transect Direction on Observed Spatial Patterns of Chlorophyll in Lake Tahoe,	LOADS (FORCES) Forces on Structures Impacted and Enveloped	Flow Net for Unsaturated Infiltration from Periodic Strip Sources, W80-06089 2G
W80-06135 2H	by Avalanches, W80-06101 2C	Seepage Vs. Terrace Density in Reclaimed Min-
LAKE WEIR (FL) Characterization of Organic Nitrogen in Natural	LONG ISLAND (NY)	eland Soil, W80-06107 2G
Waters: Its Molecular Size, Protein Content, and	Water Resources Data for New York, Water	
Interactions with Heavy Metals, W80-06114 2H	Year 1979Volume 2. Long Island, W80-06164 7C	Stochastic Parameter Estimation Procedures for Hydrologic Rainfall-Runoff Models: Corrolated
LAKES	LOUISIANA	and Heteroscedastic Error Cases, W80-06138 2A
A Numerical Model for Computation of Sedi-	Water Resources Data for Louisiana, Water	
mentation in Lakes and Reservoirs, W80-06012 2J	Year 1979Volume 1. Central and Northern Louisiana.	A Note on the Meaning of Storage Coefficient, W80-06139 2F
	W80-06169 7C	On Jacob's Approximation in Flow Through
Characterization of Organic Nitrogen in Natural Waters: Its Molecular Size, Protein Content, and	Water Resources Data for Louisiana, Water	Porous Media,
Interactions with Heavy Metals,	Year 1979Volume 2. Southern Louisiana.	W80-06143 2F
W80-06114 2H	W80-06170 7C	MATHEMATICAL STUDIES
Stratification of Aerobic Methane-Oxidizing Or-	Water Resources Data for Loiisiana, Water Year	Copper River Hydraulics Study at Million
ganisms in Lake Mendota, Madison, Wisconsin, W80-06116 2H	1979Volum 3. Coastal Louisiana. W80-06171 7C	Dollar Bridge, Alaska, W80-06051 8B
	LOWER WOOD RIVER	MATHEMATICAL STUIES
Size-Selective Predation, Light Transmission,	Geohydrologic Data for the Lower Wood River	On Some Aspects of Climatology Associated
and Oxygen Stratification: Evidence from the Recent Sediments of Manipulated Lakes,	Ground-Water Reservoir, Rhode Island, W80-06068 7C	with A Dam, W80-06071 2B
W80-06118 2H	MANAGEMENT	MEASUREMENT
The Effects of Transect Direction on Observed	Optimum Management of Water Meters: Ways	Laboratory Measurement of Sediment by Turbi-
Spatial Patterns of Chlorophyll in Lake Tahoe, W80-06135 2H	and Means, W80-06121 6B	dity, W80-06127 2J
LAND USE CONTROLS	MAPS	
Regulation of Land Use Practices for Areas Surrounding Aquifers - Economic and Legal Implications,	Maps Showing Ground-Water Conditions in the Hopi Area, Coconino and Navajo Counties, Ari- zona-1977,	MEMBER ORGANIZATIONS Water Data and Services Available from Participants in the National Water Data Exchange, W80-06047
W80-06002 6E	W80-06052 7C	
LANDFILLS	Generalized Configuration of the Bottom of the Floridan Aquifer, Southwest Florida Water	MEMBRANE PROCESSES Industrial Water Reuse with Coupled Transport
A Model to Assess Migration from Shallow Land Burial Facilities,	Management District,	Membranes. W80-06033 5D
W80-06019 7C	W80-06054 7C	W 80-06033
	Generalized Thickness of the Confining Bed	MERCURY
LAVACA RIVER BASIN Water Resources Data for Texas, Water Year	Overlying The Floridan Aquifer, Southwest Florida Water Management District,	The Distribution of Mercury, Cesium-137, and Plutonium in an Intermittent Stream at Los Alamos.
1978Volume 3. Colorado River Basin, Lavaca River Basin, Guadalupe River Basin, Nueces	W80-06055 7C	W80-06106 5B
River Basin, Rio Grande Basin, and Intervening	Water Quality of Florida Springs,	
Coastal Basins,	W80-06058 1A	METALS Research on Novel Solvent Extraction Systems
W80-06050 7C	Surficial Geology of Pulaski Quadrangle,	for Industrial Water Reuse.
LAWRENCE LAKE (MI)	Oswego County, New York,	W80-06032 5D
Fluorescence: Absorbance RatiosA Molecular-	W80-06062 7C	Industrial Water Reuse with Coupled Transport
Weight Tracer of Dissolved Organic Matter, W80-06134 5B	MARINE SEDIMENTS	Membranes. W80-06033 5D
	Distribution of Oxygen in Marine Sediments Measured with Microelectrodes,	
Occurrence of Salt and Lead in Snow Dump	W80-06117 2L	Trace Metal Budgets for a Forested Watershed in the New Jersey Pine Barrens,
Sites, W80-06085 5A	Analysis of Organic Carbon in Marine Sedi- ments,	W80-06144 5A
LIMNOLOGY	W80-06133 5A	METHANE BACTERIA Stratification of Aerobic Methane-Oxidizing Or
Windpower Time Seris Above a Temperate	MASS TRANSFER	ganisms in Lake Mendota, Madison, Wisconsin
Lake,	A Model to Assess Migration from Shallow	
W80-06112 2H	Land Burial Facilities,	MIAMI (FL)
Size-Selective Predation, Light Transmission,	W80-06019 7C	Calibration of a Distributed Routing Rainfall
and Oxygen Stratification: Evidence from the	Mass Transport: 1. A Stochastic Analysis of	Runoff Model at Four Ruban Sites Near Miami
Recent Sediments of Manipulated Lakes, W80-06118 2H	Macroscopic Dispersion,	Florida,
W80-06118 2H	W80-06149 2F	W80-06060 2A

8

UMI

MILLION DOLL AD DDIDGE (AL AGEA)		NAME AND CONTRACTOR (APP.
MILLION DOLLAR BRIDGE (ALASKA) Copper River Hydraulics Study at Million Dollar Bridge, Alaska,	A Note on the Meaning of Storage Coefficient, W80-06139 2F	NAVAJO COUNTY (AZ) Maps Showing Ground-Water Conditions in the Hopi Area, Coconino and Navajo Counties, Ari-
W80-06051 8B	A Stochastic-Conceptual Analysis of Rainfall-	zona-1977,
MINE DRAINAGE	Runoff Processes on a Hillslope, W80-06140 2E	W80-06052 7C
Environmental Contamination Through Residu-	W 80-00140 2E	NEBRASK
al Trace Metal Dispersal from a Derelict Lead- Zinc Mine,	The Effect of Soil Activity on the Chemistry of Carbonate Groundwaters,	Water Resources Data for Nebraska, Water Year 1979,
W80-06111 5B	W80-06142 2K	W80-06162 7C
MINE WASTES	A Variance-Constrained Reservoir Control	NECHES RIVER BASIN
Environmental Contamination Through Residu- al Trace Metal Dispersal from a Derelict Lead-	Problem, W80-06145 2H	Water Resources Data for Texas, Water Year 1978-Volume 1. Arkansas River Basin, Red
Zinc Mine,		River Basin, Sabine River Basin, Neches River
W80-06111 5B	Optimal Operation of Multireservoir Power Sys- tems with Stochastic Inflows,	Basin, Trinity River Basin, and Intervening Coastal Basins,
MINERALOGY	W80-06146 2E	W80-06048 7C
Chemistry of the Spring Waters of the Ouachita Mountains Excluding Hot Springs, Arkansas,	On the Statistical Characteristics of Drought	
W80-06010 1A	Events,	NEW JERSEY Trace Metal Budgets for a Forested Watershed
MINNESOTA	W80-06147 2B	in the New Jersey Pine Barrens,
Flood of July 5-7, 1978, on the South Fork	Mass Transport: 1. A Stochastic Analysis of	W80-06144 5A
Zumbro River at Rochester, Minnesota,	Macroscopic Dispersion,	NEW YORK
W80-06053 2E	W80-06149 2F	Surficial Geology of Pulaski Quadrangle, Oswego County, New York,
MIXING	Thermohaline Instability in Anisotropic Porous	W80-06062 7C
Mixing and Circulation in the Northwestern Gulf of St. Lawrence: A Study of a Buoyancy-	Media, W80-06151 2F	Water Resources Data for New York, Water
Driven Current System,		Year 1979-Volum 1. New York Excluding
W80-06122 2L	Unsteady One-Dimensional Flow Over a Plane: Partial Equilibrium and Recession Hydrographs,	Long Island,
MODEL STUDIES	W80-06153 2E	W80-06163 7C
Fluid Flow in Naturally Fractured Reservoirs, W80-06024 2F	Effect of Tail Behavior Assumptions on Flood	Water Resources Data for New York, Water
	Predictions,	Year 1979Volume 2. Long Island, W80-06164 7C
Calibration of a Distributed Routing Rainfall- Runoff Model at Four Ruban Sites Near Miami,	W80-06154 2E	
Florida,	Numerical Analysis of Infiltration into a Sand	NEW ZEALAND M2 Tidal Effects in Greater Cook Strait, New
W80-06060 2A	Profile Bounded by a Capillary Fringe,	Zealand,
Forces on Structures Impacted and Enveloped	W80-06155 2G	W80-06123 2L
by Avalanches, W80-06101 2C	Mean Summer Circulation in Lake Ontario	NITRITIES
	within The Coastal Zone, W80-06188 2H	Occurrence of A Deep Nitrite Maximum in Lake Michigan,
Time-Series Modelling of Avalanche Activity from Meteorological Data,		W80-06189 2H
W80-06102 2C	Estuarine Front Formation and Propagation, W80-06194 2L	NITROGEN
Evaluation of Jet-Roof Geometry for Snow-		Characterization of Organic Nitrogen in Natural
Cornice Control,	Analytical-Numerical Computation of Infiltra- tion,	Waters: Its Molecular Size, Protein Content, and Interactions with Heavy Metals,
W80-06103 2C	W80-06196 2G	W80-06114 2H
Sorption of Dibenzothiophene by Soils and Sedi-	Drain Depth and Subirrigation in Layered Soils,	NITROGEN FIXATION
ments, W80-06110 5B	W80-06197 3F	Nitrogen Fixation Associated with Four Species
	Storage of Freshwater in Saline Aquifers,	of Submerged Anglosperms in the Central
Windpower Time Seris Above a Temperate Lake,	W80-06199 4B	Chesapeake Bay, W80-06040 2I
W80-06112 2H	Profile Soil Moisture from Surface Measure-	NON-POINT WATER POLLUTION SOURCES
M2 Tidal Effects in Greater Cook Strait, New	ments,	Analysis of Non-Point Pollution Export from
Zealand,	W80-06200 2G	Small Catchments,
W80-06123 2L	MOISTURE CONTENT	W80-06090 5B
Experiments on Arrested Saline Wedge,	Dynamic System for Measuring Soil-Moisture Characteristics at Various Temperatures,	NORTHEAST BRAZIL
W80-06128 2L	W80-06077 2G	Diurnal Rainfall Variation in Northeast Brazil, W80-06094 2B
A Statistical Approach to the Inverse Problem	MONOSEX OFFSPRING	NORTHERN CENTRAL VALLEY BASINS (CA)
of Aquifer Hydrology, 3. Improved Solution Method and Added Perspective,	Estrogen Sex Reversal of Tilapia Aurea,	Water Resources Data for California, Water
W80-06130 2F	W80-06035 8I	Year 1978 Volume 4. Northern Central Valley
Runoff Synthesis Using Landsat and SCS	MULTIPLE PURPOSE RESERVOIRS	Basins and the Great Basin from Honey Lake Basin to Oregon State Line,
Model,	Public Attitudes Toward the Recreational Use	W80-06168 7C
W80-06131 2E	of Drinking Water Reservoirs in Massachusetts, W80-06157 6B	NORWAY
Role of Advective Terms in Tidally Generated	MUNICIPAL WATER	'Saw-Tooth' Moraines in Front of Bodalsbreen,
Residual Circulation, W80-06136 2L	The Response of Illinois Municipal Water Sys-	Southern Norway, W80-06100 2C
	tems to a Prolonged Period of Drought,	
Field Heterogeneity: Some Basic Issues, W80-06137 2G	W80-06079 2E	The Annual Cycle of Plankton Diatom Growth and Silica Production in the Inner Oslofjord,
	NATIONAL WATER DATA EXCHANGE	W80-06115 2L
Stochastic Parameter Estimation Procedures for Hydrologic Rainfall-Runoff Models: Corrolated	(NAWDEX) Water Data and Services Available from Partici-	NUECES RIVER BASIN
and Heteroscedastic Error Cases,	pants in the National Water Data Exchange,	Water Resources Data for Texas, Water Year
W80-06138 2A	W80-06047 10D	1978Volume 3. Colorado River Basin, Lavaca

River Basin, Guadalupe River Basin, Nueces River Basin, Rio Grande Basin, and Intervening	Analysis of Organic Carbon in Marine Sedi- ments,	Refrigeration Type Water Desalinisation Units, W80-06178 3A
Coastal Basins, W80-06050 7C	W80-06133 5A	Process and Apparatus for Waste Water Treat-
W 80-06030 /C	Fluorescence: Absorbance RatiosA Molecular-	ment,
NUMERICAL ANALYSIS	Weight Tracer of Dissolved Organic Matter,	W80-06179 5D
Numerical Analysis of Infiltration into a Sand	W80-06134 5B	Water Coftening Custom
Profile Bounded by a Capillary Fringe, W80-06155 2G	ORGANIZATIONS	Water Softening System, W80-06180 5F
W 80-00133	Water Data and Services Available from Partici-	
NUMERICAL MODEL	pants in the National Water Data Exchange,	Vacuum Sewage System, W80-06181 5D
A Numerical Model for Computation of Sedi-	W80-06047 10D	W80-06181
mentation in Lakes and Reservoirs, W80-06012 2J	OSLOFJORD (NORWAY)	Apparatus for the Treatment of Wastewater,
W80-06012 2J	The Annual Cycle of Plankton Diatom Growth	W80-06193 5D
NUTRIENT LOSSES	and Silica Production in the Inner Oslofjord,	PATH OF POLLUTANTS
Nutrient and Coliform Losses inRunoff from	W80-06115 2L	Movement of Heavy Metals into a Shallow
Fertilized and Sewage Sludge-Treated Soil,		Aquifer by Leakage from Sewage Oxidation
W80-06109 5B	OSWEGO COUNTY (NY)	Ponds,
NUTRIENTS	Surficial Geology of Pulaski Quadrangle, Oswego County, New York,	W80-06026 5B
Effects of Chemical Defoliation of an Abies	W80-06062 7C	PAWCATUCK RIVER BASIN (RI)
Grandis Habitat on Amounts and Chemistry of	7000000	Geohydrologic Data for the Lower Wood River
Throughfall and Stemflow,	OVERLAND FLOW	Ground-Water Reservoir, Rhode Island,
W80-06105 2B	Unsteady One-Dimensional Flow Over a Plane:	W80-06068 7C
OCEANS	Partial Equilibrium and Recession Hydrographs,	
OCEANS Determination of Cerium in Marine Sediments,	W80-06153 2E	PEAK DISCHARGE
W80-06086 5A	OXIDATION-REDUCTION POTENTIAL	Flood of July 5-7, 1978, on the South Fork
W 80-00080	Distribution of Oxygen in Marine Sediments	Zumbro River at Rochester, Minnesota,
OHIO	Measured with Microelectrodes,	W80-06053 2E
Flooding Problems in A Small Urban Water-	W80-06117 2L	PENNSYLVANIA
shedDoan Brook, Cleveland, Ohio,		Assessment of Thermal Discharges on Zoo-
W80-06182 2E	OXYGEN DEMAND	plankton in Conowingo Pond, Pennsylvania,
OIL SHALES	Fractionation of Sediment Oxygen Demand,	W80-06190 5C
Evaluation of Mutagenicity Testing of Extracts	W80-06125 5A	PERCHED WATER
from Processed Oil Shale,	PARTICLE SIZE	Movement of Heavy Metals into a Shallow
W80-06009 5A	Dissolved Oxygen in Intragravel Water of Three	Aquifer by Leakage from Sewage Oxidation
Potential for Changing Phytoplankton Growth	Tributaries to Redwood Creek, Humboldt	Ponds,
in Lake Powell Due to Oil Shale Development,	County, California,	W80-06026 5B
W80-06092 5B	W80-06066 4C	PERMEABILITY
ON-SITE DATA COLLECTIONS	PATENTS	Effects of Karst and Geologic Structure on the
A Field Exercise on Ground Water Flow Using	Removal of Color from Paper Mill Waste	Circulation of Water and Permeability in Car-
Seepage Meters and Mini-Piezometers,	Waters,	bonate Aquifers,
W80-06014 7B	W80-06017 5D	W80-06027 / 2F
	System for Electrocatalytic Treatment of Waste	THE TOTAL COMME
ON-SITE INVESTIGATIONS Field Heterogeneity: Some Basic Issues,	Water Streams,	PETROLOGY Surficial Geology of Pulaski Quadrangle,
W80-06137 2G	W80-06028 5D	Oswego County, New York,
	D 140 114 W . W .	W80-06062 7C
OPEN CHANNEL FLOW	Removal of Cyanide from Waste Water, W80-06029 5D	
Biomechanics of Vegetative Channel Linings,	W80-06029 5D	PHKYTOPLANKTON
W80-06191 2E	Process for Treating Waste Water,	Occurrence of A Deep Nitrite Maximum in
OPTIMIZATION	W80-06036 5D	Lake Michigan, W80-06189 2H
Present Methods and Prospectives in Water	36 d - 4.6 - d - D'-1 - 1 - 1 D - 16 - d 6 D00	77 00-00109
Meter Reading and Billing (Methodes Actuelles	Method for the Biological Purification of Efflu- ent and the Plant for Carrying Out the Process,	PHOSPHATES
et Prospectives en Matiere de Releve des Comp-	W80-06059 5D	The Phosphorus-Chlorophyll Relationship in
teurs et de Facturation des Consommations		Roodeplaat Dam
d'eau), W80-06120 6B	Polymer to Agglomerate Resolved Emulsions,	W80-06037 5C
W80-06120 6B	W80-06065 5D	PHOSPHOROUS
Optimum Management of Water Meters: Ways	Flotation Pump Device,	The Phosphorus-Chlorophyll Relationship in
and Means,	W80-06124 5G	Roodeplaat Dam
W80-06121 6B		W80-06037 5C
Optimal Operation of Multireservoir Power Sys-	Device for Purification of Liquids,	PHOSPHORUS
tems with Stochastic Inflows,	W80-06172 5D	The Effect of Moisture on Phosphorus Diffusion
W80-06146 2E	Center Pivot Construction for Center Pivot	in Coal Mine Spoils,
OREGON	Sprinkler,	W80-06186 5C
OREGON Water-Quality Data from Five Oregon Stream	W80-06173 3F	PHYTOPLANKTON
Ba	Water Sprinkler,	Potential for Changing Phytoplankton Growth
W80-06067 7C	W80-06174 3F	in Lake Powell Due to Oil Shale Development,
		W80-06092 5B
ORGANIC COMPOUNDS	Method of Covering Corrugated Drainage	DIEZOMETERS
Characterization of Organic Nitrogen in Natural Waters: Its Molecular Size, Protein Content, and	Tubes,	PIEZOMETERS A Field Exercise on Ground Water Flow Using
Interactions with Heavy Metals.	W80-06175 3F	Seepage Meters and Mini-Piezometers,
W80-06114 2H	Process for Recovery of Chemicals from Saline	W80-06014 7B
	Water,	
ORGANIC MATTER Oxidative Polymerization of Dissolved Phenols	W80-06176 3A	PIPES
	1100 00110	Method of Covering Commented Designation
by Soluble and Insoluble Inorganic Species,	Self-Propelling Watering Apparatus,	Method of Covering Corrugated Drainage Tubes,

The Annual Cycle of Plankton Diatom Growth	On the Statistical Characteristics of Drought Events,	Onderskeppingsverlies In 'N Savannabedekk- ing),
and Silica Production in the Inner Oslofjord,	W80-06147 2B	W80-06091 2I
W80-06115 2L	On the Definition of Droughts,	RAINFALL-RUNOFF RELATIONSHIPS
PLANNING	W80-06148 2B	Calibration of a Distributed Routing Rainfall-
Desalting Handbook for Planners.		Runoff Model at Four Ruban Sites Near Miami,
W80-06013 3A	PREDATION Size-Selective Predation, Light Transmission,	Florida, W80-06060 2A
PLUTONIUM	and Oxygen Stratification: Evidence from the	
The Distribution of Mercury, Cesium-137, and	Recent Sediments of Manipulated Lakes,	Urbanization-Induced Impacts on Infiltration
Plutonium in an Intermittent Stream at Los Alamos.	W80-06118 2H	Capacity and on Rainfall-Runoff Relation in an Hawaiian Urban Area,
W80-06106 5B	PRESERVATION	W80-06078 4C
DOLLING AND INCOME.	Water Resource Preservation: Personal Values	
POLLUTANT IDENTIFICATION Evaluation of Mutagenicity Testing of Extracts	and Public Support,	Stochastic Parameter Estimation Procedures for Hydrologic Rainfall-Runoff Models: Corrolated
from Processed Oil Shale,	W80-06043 6B	and Heteroscedastic Error Cases,
W80-06009 5A	PRIORITIES	W80-06138 2A
Analysis of Organic Carbon in Marine Sedi-	Demonstration of an Analytic Model for Estab- lishing Water Resources Development Priorities,	RECREATION FACILITIES
ments,	W80-06008 6B	Public Attitudes Toward the Recreational Use
W80-06133 5A		of Drinking Water Reservoirs in Massachusetts,
Fluorescence: Absorbance RatiosA Molecular-	PUBLIC HEALTH The Appropriate Technology of Promoting Safe	W80-06157 6B
Weight Tracer of Dissolved Organic Matter,	Water Supply in Africa,	RED RIVER BASIN
W80-06134 5B	W80-06119 5F	Water Resources Data for Texas, Water Year
POLLUTANTS	PULP WASTES	1978Volume 1. Arkansas River Basin, Red River Basin, Sabine River Basin, Neches River
The Distribution of Mercury, Cesium-137, and	Removal of Color from Paper Mill Waste	Basin, Trinity River Basin, and Intervening
Plutonium in an Intermittent Stream at Los	Waters,	Coastal Basins,
Alamos, W80-06106 5B	W80-06017 5D	W80-06048 7C
	PUMPED STORAGE	REDWOD CREEK (CA)
The Incidence of Water Quality: A County	Bolting the Roof at Drakensberg,	Dissolved Oxygen in Intragravel Water of Three
Level Analysis, W80-06150 5A	W80-06075 8E	Tributaries to Redwood Creek, Humbolds County, California,
	RADAR	W80-06066 4C
POLYCHLORINATED BIPHENYLS Transference Mechanism of Polychlorinated Bi-	Rain Drop Sizes and Rainfall Rate Measured by	
phenyl by Aquatic Organisms,	Dual-Polarization Radar, W80-06087 7B	REGIONAL ANALYSIS Regional Ground Water Flow Near a High-
W80-06004 5A	1.4	Level Radioactive Waste Repository,
POROUS MDIA	RADIAL WELLS	W80-06018 2F
Application of Recent Results in Functional	Radial Pump Saves on Water Drawing, W80-06046 8A	Regional Flood-Frequency Relations for Wes
Analysis to the Problem of Wetting Fronts,		Central Florida,
W80-06088 2G	RADIOACTIVE WASTE DISPOSAL Regional Ground Water Flow Near a High-	W80-06064 2E
POROUS MEDIA	Level Radioactive Waste Repository,	REGULATION
Singularities in Darcy Flow Through Porous	W80-06018 2F	Regulatory and Environmental Implications o
Media, W80-06021 2F	A Model to Assess Migration from Shallow	Ground Water Heat Pumps, W80-06030 6F
	Land Burial Facilities,	
The Transport of a Radioactive Salt Through a Semi-Infinite Column of Porous Medium: A	W80-06019 7C	REMOTE SENSING
Physical Model,	RADIOISOTOPES	Rain Drop Sizes and Rainfall Rate Measured by Dual-Polarization Radar,
W80-06141 5B	Determination of Cerium in Marine Sediments,	W80-06087 71
On Jacob's Approximation in Flow Through	W80-06086 5A	Runoff Synthesis Using Landsat and SC
Porous Media,	The Distribution of Mercury, Cesium-137, and	Model.
W80-06143 2F	Plutonium in an Intermittent Stream at Los	W80-06131 21
Mass Transport: 1. A Stochastic Analysis of	Alamos,	Profile Soil Moisture from Surface Measure
Macroscopic Dispersion,	W80-06106 5B	ments,
W80-06149 2F	RAINFAL	W80-06200 20
Thermohaline Instability in Anisotropic Porous	The nature of Rainfall fluctuations in Subtropi- cal West Africa,	RESEARCH AND DEVELOPMENT
Media,	W80-06095 2B	Desalting Handbook for Planners.
W80-06151 2F		W80-06013 3A
Analytical-Numerical Computation of Infiltra-	RAINFALL On Some Aspects of Climatology Associated	RESERVOIR MANAGEMENT
tion,	with A Dam,	Public Attitudes Toward the Recreational Us
W80-06196 2G	W80-06071 2B	of Drinking Water Reservoirs in Massachusett W80-06157
POTABLE WATER	Rain Drop Sizes and Rainfall Rate Measured by	
Public Attitudes Toward the Recreational Use	Dual-Polarization Radar,	RESERVOIR OPERATION
of Drinking Water Reservoirs in Massachusetts, W80-06157 6B	W80-06087 7B	A Variance-Constrained Reservoir Contro Problem.
	Diurnal Rainfall Variation in Northeast Brazil,	W80-06145 2
POTENTIAL FLOW	W80-06094 2B	
Singularities in Darcy Flow Through Porous Media.	A Stochastic-Conceptual Analysis of Rainfall-	Optimal Operation of Multireservoir Power Sy tems with Stochastic Inflows,
W80-06021 2F	Runoff Processes on a Hillslope,	W80-06146 2
	W80-06140 2E	
PRECIPITATION (ATMOSPHERIC) Preliminary Cloud Microphysics Studies for	RAINFALL INTENSITY	RESERVOIRS A Numerical Model for Computation of Sec
Texas Hiplex 1979,	Net Reainfall and Interception Loss in a Savan-	mentation in Lakes and Reservoirs,
W80-06072 2B	na Cover (Netto Reenval En	W80-06012

3

9

8

A Variance-Constrained Reservoir Control	ROUGHNESS (HYDRAULIC)	SAN BERNARD RIVER BASIN
Problem, W80-06145 2H	Biomechanics of Vegetative Channel Linings, W80-06191 2E	Water Resources Data for Texas, Water Year 1978Volume 2. San Jacinto River Basin,
RESISTANCE COEFFICIENTS	RUNOFF	Brazos River Basin, San Bernard River Basin,
Some Paradoxes in the History of Hydraulics, W80-06192 2A	Nutrient and Coliform Losses inRunoff from Fertilized and Sewage Sludge-Treated Soil,	and Intervening Coastal Basins, W80-06049 7C
RESISTIVITY	W80-06109 5B	SAN JACINTO RIVER BASIN
An Analysis of the In-Situ Resistivity of Sea Ice in Terms of Its Microstructure, W80-06104 2C	A Stochastic-Conceptual Analysis of Rainfall- Runoff Processes on a Hillslope, W80-06140 2E	Water Resources Data for Texas, Water Year 1978-Volume 2. San Jacinto River Basin, Brazos River Basin, San Bernard River Basin, and Intervening Coastal Basins,
RETENTION	RUNOFF SYNTHESIS	W80-06049 7C
Water Retention Measurement for Soils, W80-06198 2G	Runoff Synthesis Using Landsat and SCS Model,	SANTA CRUZ COUNTY (CA) Classification of Ground-Water Recharge Poten-
RETURN FLOW	W80-06131 2E	tial in Three Parts of Santa Cruz County, Cali-
Irrigation Return Water Impact on Selected Attached Diatoms in the Sacramento River, Cali-	SABINE RIVER BASIN Water Resources Data for Texas, Water Year 1978Volume 1. Arkansas River Basin, Red	fornia, W80-06056 4B
fornia, W80-06080 5C	River Basin, Sabine River Basin, Neches River Basin, Trinity River Basin, and Intervening	SATURATED FLOW Seepage Vs. Terrace Density in Reclaimed Min-
Nutrients and Associated Ion Concentrations in Irrigation Return Flow From Flooded Rice	Coastal Basins, W80-06048 7C	eland Soil, W80-06107 2G
Fields, W80-06108 5B	SACRAMENTORIVER (CA)	SEA ICE
REVERSE OSMOSIS	Irrigation Return Water Impact on Selected At- tached Diatoms in the Sacramento River, Cali-	An Analysis of the In-Situ Resistivity of Sea Ice in Terms of Its Microstructure,
Water Treatment for Small Public Supplies, W80-06007 5F	fornia, W80-06080 5C	W80-06104 2C
BHODE ISLAMD		SEDIMENT TRANSPORT
RHODE ISLAND Geohydrologic Data for the Lower Wood River Ground-Water Reservoir, Rhode Island,	SAFETY The Appropriate Technology of Promoting Safe Water Supply in Africa,	Dissolved Oxygen in Intragravel Water of Three Tributaries to Redwood Creek, Humbold County, California,
W80-06068 7C	W80-06119 5F	W80-06066 4C
Nutrients and Associated Ion Concentrations in	SALINE WATER	A Spatially Responsive Hydrologic Model to
Irrigation Return Flow From Flooded Rice Fields,	Storage of Freshwater in Saline Aquifers, W80-06022 4B	Predict Erosion and Sediment Transport, W80-06159 21
W80-06108 5B	Process for Recovery of Chemicals from Saline Water.	The Entrainment of Cohesive Sediments in
RICHARDS APPARATUS Dynamic System for Measuring Soil-Moisture	W80-06176 3A	Freshwater, W80-06187
Characteristics at Various Temperatures, W80-06077 2G	SALINE WATER-FRESHWATER INTERFACES Estuarine Front Formation and Propagation,	SEDIMENTATION A Numerical Model for Computation of Sedi
RICHESTER (MN) Flood of July 5-7, 1978, on the South Fork	W80-06194 2L	mentation in Lakes and Reservoirs, W80-06012
Zumbro River at Rochester, Minnesota, W80-06053	Storage of Freshwater in Saline Aquifers, W80-06199 4B	Bedform Spacing and flow Resistane,
RIO GRANDE BASIN	SALINITY	W80-06096 23
Water Resources Data for Texas, Water Year	On the Hydrography of Shelf Waters Off the Centeral Texas Gulf Coast,	Laboratory Measurement of Sediment by Turbi
1978Volume 3. Colorado River Basin, Lavaca River Basin, Guadalupe River Basin, Nueces	W80-06183 2L	dity, W80-06127
River Basin, Rio Grande Basin, and Intervening	SALMONOIDS	Stable Alluvial Canal Design,
Coastal Basins, W80-06050 7C	Microbiological Assessment of River Water Contamination by Fish Hatchery Effluent,	W80-06129 2E
RIVER FLOW	W80-06083 5G	SEDIMENTS
Flood of July 5-7, 1978, on the South Fork Zumbro River at Rochester, Minnesota,	SALTS Occurrence of Salt and Lead in Snow Dump	Determination of Cerium in Marine Sediments W80-06086 5A
W80-06053 2E	Sites, W80-06085 5A	Sorption of Dibenzothiophene by Soils and Sedi
RIVERS Evaluation of Induced Infiltration Between the	The Transport of a Radioactive Salt Through a	ments, W80-06110 51
River Skerne and the Magnesian Limestone in South East Durham,	Semi-Infinite Column of Porous Medium: A Physical Model,	Distribution of Oxygen in Marine Sediment Measured with Microelectrodes,
W80-06020 4B	W80-06141 5B	W80-06117 21
ROCK BOLTS Bolting the Roof at Drakensberg, W80-06075 8E	Thermohaline Instability in Anisotropic Porous Media, W80-06151 2F	Fractionation of Sediment Oxygen Demand, W80-06125 5A
		A Sampler for Cohesive Sediment in the Benthi
ROCK EXCAVATION Bolting the Roof at Drakensberg,	SAMPLING Draft, Construction and Operation of a Sequen-	Boundary Layer, W80-06132
W80-06075 8E	tial Rain Sampler, W80-06084 7B	
ROGERS PASS (B.C.)		The Entrainment of Cohesive Sediments in Freshwater,
Time-Series Modelling of Avalanche Activity from Meteorological Data,	A Sampler for Cohesive Sediment in the Benthic Boundary Layer,	W80-06187 2
W80-06102 2C	W80-06132 7B	SEEPAGE
ROTARY DRILLING	Trace Metal Budgets for a Forested Watershed	A Field Exercise on Ground Water Flow Using
Drill Provides Unmixed Samples, W80-06045 7B	in the New Jersey Pine Barrens, W80-06144 5A	Seepage Meters and Mini-Piezometers, W80-06014

Seepage Vs. Terrace Density in Reclaimed Min-	SLOPES	SOILS
eland Soil,	A Stochastic-Conceptual Analysis of Rainfall-	Sorption of Dibenzothiophene by Soils and Sedi-
W80-06107 2G	Runoff Processes on a Hillslope,	ments,
	W80-06140 2E	W80-06110 5B
SEPARATION TECHNIQUES		W 90-00110 3D
Removal of Cyanide from Waste Water,	SMALL WATERSHEDS	SOLAR POWER
W80-06029 5D	Water-Quality Data from Five Oregon Stream	Solar Powered Electrodialysis - Part I: Design
	Ba	of a Solar Powered Electrodialysis System for
Research on Novel Solvent Extraction Systems	W80-06067 7C	
for Industrial Water Reuse.		Desalting Remote, Brackish Water Sources.
W80-06032 5D	SNOW	W80-06001 3A
	Occurrence of Salt and Lead in Snow Dump	COLUMN DISTURBON
Industrial Water Reuse with Coupled Transport	Sites,	SOLAR RADIATION
Membranes.	W80-06085 5A	Mapping Potential Evapotranspiration in Hilly
W80-06033 5D		Terrain,
	SNOW CORNICE	W80-06069 2D
Refrigeration Type Water Desalinisation Units,	Evaluation of Jet-Roof Geometry for Snow-	
W80-06178 3A	Cornice Control,	SOLVENT EXTRACTION
SEPTIC TANKS	W80-06103 2C	Research on Novel Solvent Extraction Systems
Ground Water Pollution by Septic Tank Drain	CHICAGO AND CONTRACTOR	for Industrial Water Reuse.
	SNOW MANAGEMENT	W80-06032 5D
Fields,	A Recommendation for the Application of the	
W80-06023 5G	Roch Index for Slab Avalanche Release,	SORPTION
SEWAGE EFFLUENTS	W80-06099 2C	Sorption of Dibenzothiophene by Soils and Sedi-
	Forces on Standard Impacted and Paveland	ments,
Assessment of Sewage Lagoons as Potential Fish	Forces on Structures Impacted and Enveloped by Avalanches,	W80-06110 5B
Culture Sites in West Central Wisconsin,		
W80-06076 5D	W80-06101 2C	SOUNDING
SEWAGE LAGOONS	Time-Series Modelling of Avalanche Activity	Performane of V.H.F. Aerials Close To a Snow
Movement of Heavy Metals into a Shallow	from Meteorological Data,	Surface,
Aquifer by Leakage from Sewage Oxidation	W80-06102 2C	W80-06098 2C
	W 80-00102 2C	W 60-00096 2C
Ponds,	Evaluation of Jet-Roof Geometry for Snow-	SOUNDS (NC)
W80-06026 5B	Cornice Control,	Nitrogen Fixation Associated with Four Species
Assessment of Sewage Lagoons as Potential Fish	W80-06103 2C	of Submerged Anglosperms in the Central
	W 00-00103	
Culture Sites in West Central Wisconsin, W80-06076 5D	SOCIAL VALUES	Chesapeake Bay,
W 80-00076	Water Resource Preservation: Personal Values	W80-06040 21
SEWAGE SLUDGE	and Public Support,	SOUTH AFRICA
Nutrient and Coliform Losses inRunoff from	W80-06043 6B	
Fertilized and Sewage Sludge-Treated Soil,		The Phosphorus-Chlorophyll Relationship in
W80-06109 5B	SOIL DISPOSAL FIELDS	Roodeplaat Dam
W 80-00109	Ground Water Pollution by Septic Tank Drain	W80-06037 5C
SEWAGE TREATMENT	Fields,	
System for Electrocatalytic Treatment of Waste	W80-06023 5G	Mapping Potential Evapotranspiration in Hilly
Water Streams,		Terrain,
W80-06028 5D	SOIL EROSION	W80-06069 2D
11 00-00020	Erosivity Values for Individual Design Storms,	
SHALLOW WATER	W80-06195 2J	Tensiometer-Controlled Medium Frequency
Unsteady One-Dimensional Flow Over a Plane:		Topsoil Irrigation: A Technique to Improve Ag-
Partial Equilibrium and Recession Hydrographs,	SOIL MANAGEMENT	ricultural Water Management,
W80-06153 2E	Tensiometer-Controlled Medium Frequency	W80-06070 3F
***************************************	Topsoil Irrigation: A Technique to Improve Ag-	
SHELF WATERS	ricultural Water Management,	Water from the Waterskloof,
On the Hydrography of Shelf Waters Off the	W80-06070 3F	W80-06073 8A
Centeral Texas Gulf Coast,	CON MOTORING	
W80-06183 2L	SOIL MOISTURE	Coping with the One-in-ten-years Storm,
	Dynamic System for Measuring Soil-Moisture	W80-06074 4A
SHOCK-RECOVERY INDEX	Characteristics at Various Temperatures,	N. D. 1611 12.
The Measurement of Temperature Tolerance:	W80-06077 2G	Net Reainfall and Interception Loss in a Savan-
Verification of an Index,	On the Definition of Droughts,	na Cover (Netto Reenval En
W80-06041 2L	W80-06148 2B	Onderskeppingsverlies In 'N Savannabedekk-
	W 00-00140 2B	ing),
SILICA	Profile Soil Moisture from Surface Measure-	W80-06091 21
The Annual Cycle of Plankton Diatom Growth	ments,	
and Silica Production in the Inner Oslofjord,	W80-06200 2G	SOUTH DAKOTA
W80-06115 2L	11 00-00200	Water Resources Data for South Dakota, Water
	SOIL PROFILES	Year 1979,
SIMULATION MODEL	Profile Soil Moisture from Surface Measure-	W80-06165 7C
The Impact of Nonstructural Flood Abatement	ments,	
Measures on Patterns of Industrial Location,	W80-06200 2G	SOUTH FORK ZUMBRO RIVER (MN)
W80-06011 6F		Flood of July 5-7, 1978, on the South Fork
ORIGINA AR CHIRD LONG	SOIL WATER	Zumbro River at Rochester, Minnesota,
SINGULAR SURFACES	Water Retention Measurement for Soils,	W80-06053 2E
Application of Recent Results in Functional	W80-06198 2G	
Analysis to the Problem of Wetting Fronts,		SOUTHER CENTRAL VALLEY BASINS
W80-06088 2G	SOIL WATER MOVEMENT	Water Resources Data for California, Water
CLODE PROTECTION	Field Heterogeneity: Some Basic Issues,	Year 1978Volume 3. Sothr Central Valley
SLOPE PROTECTION	W80-06137 2G	Basins and the Great Basin from Walker River
Evaluation of Jet-Roof Geometry for Snow-	The Towns of a B. Marrier Cale Tt.	to Truckee River,
Cornice Control,	The Transport of a Radioactive Salt Through a	W80-06167 7C
W80-06103 2C	Semi-Infinite Column of Porous Medium: A	
SLOPE STABILITY	Physical Model,	SOUTHERN LOUISIANA
A Recommendation for the Application of the	W80-06141 5B	Water Resources Data for Louisiana, Water
	Design Death and Subjection in Laurent Sails	Year 1979Volume 2. Southern Louisiana.
Roch Index for Slab Avalanche Release,	Drain Depth and Subirrigation in Layered Soils, W80-06197	
W80-06099 2C	W80-06197 3F	W80-06170 7C

DISTRICT	Estuarine Front Formation and Propagation,	Year 1979,
Generalized Configuration of the Bottom of the Floridan Aquifer, Southwest Florida Water	W80-06194 2L	W80-06161 7C
Management District, W80-06054 7C	Regional Flood-Frequency Relations for West	Water Resources Data for Nebraska, Water Year 1979,
	Central Florida, W80-06064 2E	W80-06162 7C
Generalized Thickness of the Confining Bed Overlying The Floridan Aquifer, Southwest Florida Water Management District,	On the Statistical Characteristics of Drought	Water Resources Data for New York, Water Year 1979Volum 1. New York Excluding
W80-06055 7C	Events, W80-06147 2B	Long Island, W80-06163 7C
SPILLWAY BREADTH Optimum Spillway Breadth for Gravity Dams,	On the Definition of Droughts,	Water Resources Data for New York, Water
W80-06097 2H	W80-06148 2B	Year 1979Volume 2. Long Island, W80-06164 7C
SPILLWAYS	STREAMS Water-Quality Data from Five Oregon Stream	Water Resources Data for South Dakota, Water
Optimum Spillway Breadth for Gravity Dams, W80-06097 2H	Ba W80-06067 7C	Year 1979, W80-06165 7C
SPOIL BANKS The Effect of Moisture on Phosphorus Diffusion	Oxidative Polymerization of Dissolved Phenols	Water Resources Data for California, Water
in Coal Mine Spoils,	by Soluble and Insoluble Inorganic Species, W80-06113 5A	Year 1978Volume 2. Pacific Slope Basins from Arroyo Grande to Oregon State Line Except
W80-06186 5C	STRUCTURAL GEOLOGY	Central Valley,
SPRINGS	Effects of Karst and Geologic Structure on the	W80-06166 7C
Chemistry of the Spring Waters of the Ouachita Mountains Excluding Hot Springs, Arkansas,	Circulation of Water and Permeability in Car- bonate Aquifers,	Water Resources Data for California, Water Year 1978-Volume 3. Sothr Central Valley
W80-06010 1A	W80-06027 2F	Basins and the Great Basin from Walker River
Water Quality of Florida Springs, W80-06058 1A	STRUCTURES	to Truckee River, W80-06167 7C
	Forces on Structures Impacted and Enveloped by Avalanches,	Water Resources Data for California, Water
SPRINKLER IRRIGATION Water Sprinkler,	W80-06101 2C	Year 1978 Volume 4. Northern Central Valley
W80-06174 3F	SUBMERGED PLANTS	Basins and the Great Basin from Honey Lake
	Nitrogen Fixation Associated with Four Species	Basin to Oregon State Line, W80-06168 7C
ST LAWRENCE RIVER Mixing and Circulation in the Northwestern	of Submerged Anglosperms in the Central	
Gulf of St. Lawrence: A Study of a Buoyancy- Driven Current System,	Chesapeake Bay, W80-06040 2I	Water Resources Data for Louisiana, Water Year 1979Volume 1. Central and Northern
W80-06122 2L	SUBSURFACE DRAINAGE	Louisiana. W80-06169 7C
STEMFLOW	Drain Depth and Subirrigation in Layered Soils,	
Net Reainfall and Interception Loss in a Savan-	W80-06197 3F	Water Resources Data for Louisiana, Water
na Cover (Netto Reenval En Onderskeppingsverlies In 'N Savannabedekk-	SUBSURFACE IRRIGATION Drain Depth and Subirrigation in Layered Soils,	Year 1979Volume 2. Southern Louisiana. W80-06170 7C
ing), W80-06091 2I	W80-06197 3F	Water Resources Data for Loiisiana, Water Year
	SUBSURFACE MAPPING	1979Volum 3. Coastal Louisiana. W80-06171 7C
STORAGE Storage of Freshwater in Saline Aquifers,	Potential Subsurface Zones for Liquid-Waste Storage in Florida,	
W80-06022 4B	W80-06057 5E	SUSQUEHANNA RIVER BASIN The Impact of Nonstructural Flood Abatement Measures on Patterns of Industrial Location,
Depth Constraints on Thermal Storage Wells, W80-06025 8B	SUMMER Mean Summer Circulation in Lake Ontario	W80-06011 6F
Optimum Spillway Breadth for Gravity Dams,	within The Coastal Zone, W80-06188 2H	TEMPERATURE Dynamic System for Measuring Soil-Moisture
W80-06097 2H		Characteristics at Various Temperatures,
STORAGE COEFFICIENT	SURFACE WATER Efficiency and Equity in Management of Agri-	W80-06077 2G
A Note on the Meaning of Storage Coefficient, W80-06139 2F	cultural Water Supplies, W80-06081 6C	Thermohaline Instability in Anisotropic Porous Media,
STORM RUNOFF	SURFACE WATERS	W80-06151 2F
Urbanization-Induced Impacts on Infiltration	Water Resources Data for Texas, Water Year	TEMPERATURE TOLERANCE
Capacity and on Rainfall-Runoff Relation in an Hawaiian Urban Area,	1978Volume 1. Arkansas River Basin, Red River Basin, Sabine River Basin, Neches River	Genetic and Physiological Adaptation of the Copepod Eurytemora Affinis to Seasonal Tem-
W80-06078 4C	Basin, Trinity River Basin, and Intervening Coastal Basins.	peratures,
Analysis of Non-Point Pollution Export from Small Catchments,	W80-06048 7C	W80-06038 2L
W80-06090 5B	Water Resources Data for Texas, Water Year	The Measurement of Temperature Tolerance: Verification of an Index,
STORM STRUCTURE	1978Volume 2. San Jacinto River Basin, Brazos River Basin, San Bernard River Basin,	W80-06041 2L
Preliminary Cloud Microphysics Studies for Texas Hiplex 1979,	and Intervening Coastal Basins, W80-06049 7C	TENSIOMETERS Tensiometer-Controlled Medium Frequency
W80-06072 2B		Topsoil Irrigation: A Technique to Improve Ag-
STORMS	Water Resources Data for Texas, Water Year 1978Volume 3. Colorado River Basin, Lavaca	ricultural Water Management, W80-06070 3F
Downwelling over the Southern California Shelf,	River Basin, Guadalupe River Basin, Nueces	
W80-06184 2L	River Basin, Rio Grande Basin, and Intervening Coastal Basins,	Dynamic System for Measuring Soil-Moisture Characteristics at Various Temperatures,
STRATIFICATION	W80-06050 7C	W80-06077 2G
Stratification of Aerobic Methane-Oxidizing Or- ganisms in Lake Mendota, Madison, Wisconsin,	Water Resources Data for Connecticut, Water Year 1979,	TEXAS Water Resources Data for Texas, Water Year
W80-06116 2H	W80-06160 7C	1979 Volume 1 Askanese Diver Bosin Der

1

8

MI

River Basin, Sabine River Basin, Neches River Basin, Trinity River Basin, and Intervening	TORONTO (ONTARIO) Occurrence of Salt and Lead in Snow Dump	Analysis of Non-Point Pollution Export from Small Catchments,
Coastal Basins,	Sites.	W80-06090 5B
W80-06048 7C	W80-06085 5A	
Water Resources Data for Texas, Water Year	TOXICITY	Runoff Synthesis Using Landsat and SCS Model.
1978Volume 2. San Jacinto River Basin, Brazos River Basin, San Bernard River Basin,	Evaluation of Mutagenicity Testing of Extracts from Processed Oil Shale,	W80-06131 2E
and Intervening Coastal Basins,	W80-06009 5A	Flooding Problems in A Small Urban Water-
W80-06049 7C	Delayed Behavioral Responses of the Balack-	shedDoan Brook, Cleveland, Ohio, W80-06182 2E
Water Resources Data for Texas, Water Year	nose Dace (Rhinichthys Atratulus) to Chlora- mines and Free Chlorine,	URBANIZATION
1978Volume 3. Colorado River Basin, Lavaca River Basin, Guadalupe River Basin, Nueces	W80-06039 5C	Urbanization-Induced Impacts on Infiltration
River Basin, Rio Grande Basin, and Intervening	Acute Toxicity to Goldfish of Mixtures of	Capacity and on Rainfall-Runoff Relation in an Hawaiian Urban Area,
Coastal Basins, W80-06050 7C	Chloramines, Copper, and Linear Alkylate Sul- fonate,	W80-06078 4C
On the Hydrography of Shelf Waters Off the	W80-06042 5A	VARIABILITY
Centeral Texas Gulf Coast,	TRACE ELEMENTS	The nature of Rainfall fluctuations in Subtropi-
W80-06183 2L	Organic-Rich Colloidal Marerial in Estuaries	cal West Africa, W80-06095 2B
TEXAS GULF COAST	and Its Alteration by Chlorination, W80-06093 5A	ALTECOPIE A TRACE I PROPERTIES
On the Hydrography of Shelf Waters Off the	W80-06093 5A	VEGETATION EFFECTS Biomechanics of Vegetative Channel Linings,
Centeral Texas Gulf Coast, W80-06183 2L	Trace Metal Budgets for a Forested Watershed in the New Jersey Pine Barrens,	W80-06191 2E
W80-06183 2L	W80-06144 5A	VIRUSES
TEXAS HIGH PLAINS		Microbiological Assessment of River Water
New Irrigation System Design for Maximizing Irrigation Efficiency and Increasing Rainfall Uti-	TRACERS The Transport of a Radioactive Salt Through a	Contamination by Fish Hatchery Effluent,
lization,	Semi-Infinite Column of Porous Medium: A	W80-06083 5G
W80-06003 3F	Physical Model,	WALES
THE GREAT BASIN (CA)	W80-06141 5B	Environmental Contamination Through Residu-
Water Resources Data for California, Water	TRIBUTARIES	al Trace Metal Dispersal from a Derelict Lead- Zinc Mine,
Year 1978 Volume 4. Northern Central Valley	Dissolved Oxygen in Intragravel Water of Three Tributaries to Redwood Creek, Humboldt	W80-06111 5B
Basins and the Great Basin from Honey Lake Basin to Oregon State Line.	County, California,	A Sampler for Cohesive Sediment in the Benthic
W80-06168 7C	W80-06066 4C	Boundary Layer,
THE OPEN CALLANDA AND A STATE OF COLUMN ASSESSMENT	TRINITY RIVER BASIN	W80-06132 7B
THEORETICAL ANALYSIS Field Heterogeneity: Some Basic Issues,	Water Resources Data for Texas, Water Year	WALKER RIVER
W80-06137 2G	1978Volume 1. Arkansas River Basin, Red River Basin, Sabine River Basin, Neches River	Water Resources Data for California, Water
	Basin, Trinity River Basin, and Intervening	Year 1978-Volume 3. Sothr Central Valley
THERMAL POLLUTION Assessment of Thermal Discharges on Zoo-	Coastal Basins,	Basins and the Great Basin from Walker River to Truckee River,
plankton in Conowingo Pond, Pennsylvania,	W80-06048 7C	W80-06167 7C
W80-06190 5C	TRUCKEE RIVER	HI A OVERSTONIAN
THERMAL WATER	Water Resources Data for California, Water	WASHINGTON Water Resource Preservation: Personal Values
Depth Constraints on Thermal Storage Wells,	Year 1978Volume 3. Sothr Central Valley Basins and the Great Basin from Walker River	and Public Support,
W80-06025 8B	to Truckee River,	W80-06043 6B
THUNDERSTORMS	W80-06167 7C	WASTE DISPOSAL
Flood of July 5-7, 1978, on the South Fork	TUNNEL CONSTRUCTION	The Distribution of Mercury, Cesium-137, and
Zumbro River at Rochester, Minnesota,	Water from the Waterskloof,	Plutonium in an Intermittent Stream at Los
W80-06053 2E	W80-06073 8A	Alamos, W80-06106 5B
TIDAL EFFECTS	TUNNEL LININGS	
M2 Tidal Effects in Greater Cook Strait, New	Water from the Waterskloof,	WASTE STORAGE Potential Subsurface Zones for Liquid-Waste
Zealand,	W80-06073 8A	Storage in Florida,
W80-06123 2L	UNDERGROUND POWERPLANTS	W80-06057 5E
TIDAL WATERS	Bolting the Roof at Drakensberg,	WASTE TREATMENT
Role of Advective Terms in Tidally Generated	W80-06075 8E	Water Quality Control and Management of
Residual Circulation, W80-06136 2L	UNDERGROUND WASTE DISPOSAL	Animal Wastes Through Culture with Selected
	Potential Subsurface Zones for Liquid-Waste Storage in Florida,	Fishes, W80-06034 5D
TIDES	W80-06057 5E	
M2 Tidal Effects in Greater Cook Strait, New Zealand,	TIME ATTID ATTED ELOW	WASTE WATER
W80-06123 2L	UNSATURATED FLOW Flow Net for Unsaturated Infiltration from Peri-	Assessment of Sewage Lagoons as Potential Fish Culture Sites in West Central Wisconsin,
TILAPIA AUREA	odic Strip Sources, W80-06089 2G	W80-06076 5D
Estrogen Sex Reversal of Tilapia Aurea,		WASTE WATER TREATMENT
W80-06035	URBAN HYDROLOGY	Removal of Color from Paper Mill Waste
TOPOGRAPHY	Flooding Problems in A Small Urban Water- shedDoan Brook, Cleveland, Ohio,	Waters, W80-06017 5D
Mapping Potential Evapotranspiration in Hilly	W80-06182 2E	W80-06017 5D
Terrain,		System for Electrocatalytic Treatment of Waste
W80-06069 2D	URBAN RUNOFF Calibration of a Distributed Routing Rainfall-	Water Streams, W80-06028 5D
'Saw-Tooth' Moraines in Front of Bodalsbreen,	Runoff Model at Four Ruban Sites Near Miami,	
Southern Norway,	Florida,	Removal of Cyanide from Waste Water,

WASTE WATER TREATMENT

Process for Treating Waste Water,	WATER LEVELS	WATER PURIFICATION
W80-06036 5D	Generalized Configuration of the Bottom of the Floridan Aquifer, Southwest Florida Water	Method for the Biological Purification of Efflu- ent and the Plant for Carrying Out the Process,
Method for the Biological Purification of Efflu-	Management District,	W80-06059 5D
ent and the Plant for Carrying Out the Process,	W80-06054 7C	WATER QUALITY
W80-06059 5D	WATER MANAGEMENT (APPLIED)	Management Model of a Ground Water System
Polymer to Agglomerate Resolved Emulsions,	Management Model of a Ground Water System	with a Transient Pollutant Source,
W80-06065 5D	with a Transient Pollutant Source, W80-06015 5G	W80-06015 5G
Assessment of Sewage Lagoons as Potential Fish		Ground Water Simulation Using a One Dimen-
Culture Sites in West Central Wisconsin,	A Variance-Constrained Reservoir Control	sional Flow Model,
W80-06076 5D	Problem, W80-06145 2H	W80-06044 7C
Device for Purification of Liquids,		Water Resources Data for Texas, Water Year
W80-06172 5D	WATER MEASUREMENT Dynamic System for Measuring Soil-Moisture	1978Volume 1. Arkansas River Basin, Red River Basin, Sabine River Basin, Neches River
Process for Recovery of Chemicals from Saline	Characteristics at Various Temperatures,	Basin, Trinity River Basin, and Intervening
Water,	W80-06077 2G	Coastal Basins,
W80-06176 3A	Present Methods and Prospectives in Water	W80-06048 7C
Process and Apparatus for Waste Water Treat-	Meter Reading and Billing (Methodes Actuelles	Water Resources Data for Texas, Water Year
ment,	et Prospectives en Matiere de Releve des Comp-	1978Volume 2. San Jacinto River Basin,
W80-06179 5D	teurs et de Facturation des Consommations	Brazos River Basin, San Bernard River Basin,
Vacuum Sewage System,	d'eau),	and Intervening Coastal Basins,
W80-06181 5D	W80-06120 6B	W80-06049 7C
	Optimum Management of Water Meters: Ways	Water Resources Data for Texas, Water Year
Apparatus for the Treatment of Wastewater,	and Means,	1978Volume 3. Colorado River Basin, Lavaca
W80-06193 5D	W80-06121 6B	River Basin, Guadalupe River Basin, Nueces
WATER CHEMISTRY	WATER POLLLUTION TREATMENT	River Basin, Rio Grande Basin, and Intervening Coastal Basins,
Oxidative Polymerization of Dissolved Phenols	Process for Treating Waste Water,	W80-06050 7C
by Soluble and Insoluble Inorganic Species,	W80-06036 5D	
W80-06113 5A	WATER POLLUTION	Water Quality of Florida Springs, W80-06058
The Effect of Soil Activity on the Chemistry of	Ground Water Pollution by Septic Tank Drain	W 80-00038
Carbonate Groundwaters,	Fields, W80-06023 5G	Water-Quality Data for Canals in Eastern
W80-06142 2K	W 80-00023	Broward County, Florida, 1975-78, W80-06061 7C
WATER CIRCULATION	Relationships Between Heterotrophic Bacteria	W 80-00001
Mixing and Circulation in the Northwestern	and Pollution in an Industrialized Estuary, W80-06126 5B	Dissolved Oxygen in Intragravel Water of Three
Gulf of St. Lawrence: A Study of a Buoyancy-	W 80-00120 JB	Tributaries to Redwood Creek, Humboldt County, California,
Driven Current System, W80-06122 2L	WATER POLLUTION EFFECTS	W80-06066 4C
	Assessment of Thermal Discharges on Zoo- plankton in Conowingo Pond, Pennsylvania,	
M2 Tidal Effects in Greater Cook Strait, New	W80-06190 5C	Water-Quality Data from Five Oregon Stream Ba
Zealand, W80-06123 2L	WATER BOLL WITCH COURSE	W80-06067 7C
	WATER POLLUTION SOURCES Analysis of Non-Point Pollution Export from	
Role of Advective Terms in Tidally Generated	Small Catchments,	Nutrients and Associated Ion Concentrations in Irrigation Return Flow From Flooded Rice
Residual Circulation, W80-06136 2L	W80-06090 5B	Fields,
W 80-00130	Potential for Changing Phytoplankton Growth	W80-06108 5B
Downwelling over the Southern California	in Lake Powell Due to Oil Shale Development,	The Associate Technology of December Sefe
Shelf, W80-06184 2L	W80-06092 5B	The Appropriate Technology of Promoting Safe Water Supply in Africa,
W 80-00104 2L	Environmental Contamination Through Residu-	W80-06119 5F
WATER CIRCULTION	al Trace Metal Dispersal from a Derelict Lead-	The Effects of Tourset Direction on Observed
Mean Summer Circulation in Lake Ontario within The Coastal Zone,	Zinc Mine,	The Effects of Transect Direction on Observed Spatial Patterns of Chlorophyll in Lake Tahoe,
W80-06188 2H	W80-06111 5B	W80-06135 2H
	WATER POLLUTION TREATMENT	The Incidence of Water Quality: A County
WATER CONTROL	Method for the Biological Purification of Efflu-	Level Analysis,
Coping with the One-in-ten-years Storm, W80-06074 4A	ent and the Plant for Carrying Out the Process, W80-06059 5D	W80-06150 5A
		Public Attitudes Toward the Recreational Use
WATER COSTS Efficiency and Equity in Management of Agri-	Polymer to Agglomerate Resolved Emulsions, W80-06065 5D	of Drinking Water Reservoirs in Massachusetts,
cultural Water Supplies,	35	W80-06157 6B
W80-06081 6C	Device for Purification of Liquids,	Water Resources Data for Wisconsin, Water
Comp Bandardian and Wassa County Changes in	W80-06172 5D	Year 1979,
Crop Production and Water Supply Characteris- tics of Kern County,	Process and Apparatus for Waste Water Treat-	W80-06161 7C
W80-06082 6C	ment,	Water Resources Data for Nebraska, Water
WATER DEVELOPMENT	W80-06179 5D	Year 1979,
Demonstration of an Analytic Model for Estab-	Vacuum Sewage System,	W80-06162 7C
lishing Water Resources Development Priorities,		Water Resources Data for New York, Water
W80-06008 6B	Apparatus for the Treatment of Wastewater,	Year 1979Volum 1. New York Excluding
WATER DISTRIBUTION	W80-06193 5D	
Planning Groundwater Supply Systems for	WATER PROPERTIES	W80-06163 7C
Urban Growth: Applications to West Lafayette,	Oxidative Polymerization of Dissolved Phenols	
Indiana,	by Soluble and Insoluble Inorganic Species,	Year 1979Volume 2. Long Island,
W80-06158 4E	W80-06113 5A	W80-06164 70

Water Resources Data for South Dakota, Water Year 1979,	WATER TREATMENT Water Treatment for Small Public Supplies,
W80-06165 7C	W80-06007 5F
Water Resources Data for California, Water Year 1978Volume 2. Pacific Slope Basins from	Flotation Pump Device, W80-06124 5G
Arroyo Grande to Oregon State Line Except Central Valley,	Water Softening System,
W80-06166 7C	W80-06180 5F
Water Resources Data for California, Water Year 1978Volume 3. Sothr Central Valley Basins and the Great Basin from Walker River	WATER WELLS A Layman's Guide to Iron Bacteria Problems in Wells, W80-06016 5C
to Truckee River, W80-06167 7C	Depth Constraints on Thermal Storage Wells,
Water Resources Data for California, Water Year 1978 Volume 4. Northern Central Valley	W80-06025 8B Maps Showing Ground-Water Conditions in the
Basins and the Great Basin from Honey Lake Basin to Oregon State Line,	Hopi Area, Coconino and Navajo Counties, Arizona1977,
W80-06168 7C	W80-06052 7C
Water Resources Data for Louisiana, Water Year 1979Volume 1. Central and Northern Louisiana.	WATERSHED MANAGEMENT Water from the Waterskloof,
W80-06169 7C	W80-06073 8A
Water Resources Data for Louisiana, Water	Coping with the One-in-ten-years Storm, W80-06074 4A
Year 1979Volume 2. Southern Louisiana. W80-06170 7C	WATERSHEDS (BASINS)
W80-06170 7C	Hydrology of Jumper Creek Canal Basin, Sump-
Water Resources Data for Loiisiana, Water Year 1979Volum 3. Coastal Louisiana.	ter County, Florida, W80-06063 4A
W80-06171 7C	
WATER QUALITY CONTROL	WELL SPACING Planning Groundwater Supply Systems for
Water Softening System,	Urban Growth: Applications to West Lafayette,
W80-06180 5F	Indiana, W80-06158 4B
WATER QUALLITY	W 80-00138
Water Resources Data for Connecticut, Water Year 1979.	WELLS Chemistry of the Spring Waters of the Ouachita
W80-06160 7C	Mountains Excluding Hot Springs, Arkansas, W80-06010
WATER RESOURCES	WEST-CENTRAL FLORIDA
Water Resource Preservation: Personal Values and Public Support, W80-06043 6B	Regional Flood-Frequency Relations for West Central Florida,
	W80-06064 2E
WATER REUSE	WETTING
Research on Novel Solvent Extraction Systems for Industrial Water Reuse.	Application of Recent Results in Functional Analysis to the Problem of Wetting Fronts,
W80-06032 5D	W80-06088 2G
WATER SHORTAGE The Response of Illinois Municipal Water Sys-	WETTING FRONTS
tems to a Prolonged Period of Drought, W80-06079 2E	Application of Recent Results in Functional Analysis to the Problem of Wetting Fronts, W80-06088 2G
WATER SOFTENING	
Water Softening System,	WINDS Windpower Time Seris Above a Temperate
W80-06180 5F	Lake,
WATER SUPPLY	W80-06112 2H
Efficiency and Equity in Management of Agri-	WISCONSIN
cultural Water Supplies, W80-06081 6C	Stratification of Aerobic Methane-Oxidizing Or- ganisms in Lake Mendota, Madison, Wisconsin,
Crop Production and Water Supply Characteris-	W80-06116 2H
tics of Kern County,	Water Resources Data for Wisconsin, Water
W80-06082 6C	Year 1979, W80-06161 7C
Planning Groundwater Supply Systems for Urban Growth: Applications to West Lafayette,	
Indiana,	ZOOPLANKTON Assessment of Thermal Discharges on Zoo-
W80-06158 4B	plankton in Conowingo Pond, Pennsylvania,
WATER SUPPLY DEVELOPMENT	W80-06190 5C
The Appropriate Technology of Promoting Safe Water Supply in Africa,	
W80-06119 5F	

WATER TEMPERATURE
On the Hydrography of Shelf Waters Off the
Centeral Texas Gulf Coast,
W80-06183 2L

C 1

8

AUTHOR INDEX

ABBOTT, M. R. The Effects of Transect Direction on Observed Spatial Patterns of Chlorophyll in Lake Tahoe,	BARBER, W. F. JR. Copper River Hydraulics Study at Million Dollar Bridge, Alaska,	BRASWELL, J. W. Water Softening System, W80-06180 5F
W80-06135 Chlorophyn in Lake Talloc,	W80-06051 8B	
ADAMS, V. D. Evaluation of Mutagenicity Testing of Extracts from Processed Oil Shale, W80-06009 5A	BARR, G. L. Generalized Configuration of the Bottom of the Floridan Aquifer, Southwest Florida Water	BREZONIK, P. L. Characterization of Organic Nitrogen in Natural Waters: Its Molecular Size, Protein Content, and Interactions with Heavy Metals,
Same by the State of the State	Management District, W80-06054 7C	W80-06114 2H
Potential for Changing Phytoplankton Growth in Lake Powell Due to Oil Shale Development, W80-06092 5B	Generalized Thickness of the Confining Bed Overlying The Floridan Aquifer, Southwest Florida Water Management District,	BROOKS, A. S. Occurrence of A Deep Nitrite Maximum in Lake Michigan,
AIDE, R. J. Flotation Pump Device, W80-06124 5G	W80-06055 7C	W80-06189 2H BROOKS, R. H.
AIKENS, A. E.	BATU, V. Flow Net for Unsaturated Infiltration from Peri-	Water Retention Measurement for Soils, W80-06198 2G
A Model to Assess Migration from Shallow Land Burial Facilities,	odic Strip Sources, W80-06089 2G	BROWN, K. W.
W80-06019 7C	BAUR, R. J.	Nutrients and Associated Ion Concentrations in Irrigation Return Flow From Flooded Rice
ALI, S. Sorption of Dibenzothiophene by Soils and Sediments,	Water Quality Control and Management of Animal Wastes Through Culture with Selected Fishes,	Fields, W80-06108 5B
W80-06110 5B	W80-06034 5D	BRYANT, R.
ANDERS, R. B. Effects of Karst and Geologic Structure on the	BAYER, D. E. Irrigation Return Water Impact on Selected At-	A Sampler for Cohesive Sediment in the Benthic Boundary Layer, W80-06132 7B
Circulation of Water and Permeability in Car- bonate Aquifers, W80-06027 2F	tached Diatoms in the Sacramento River, California, W80-06080 5C	BRYSON, M. C. Effect of Tail Behavior Assumptions on Flood
ANDERSON, A.	BEANE, F. T.	Predictions,
Hydrology of Jumper Creek Canal Basin, Sump-	Method of Covering Corrugated Drainage	W80-06154 2E
ter County, Florida, W80-06063 4A	Tubes, W80-06175 3F	BUCK, D. H. Water Quality Control and Management of
ANDERSON, T. D. Effects of Chemical Defoliation of an Abies Grandis Habitat on Amounts and Chemistry of	BERNAT, J-P. Removal of Cyanide from Waste Water, W80-06029 5D	Animal Wastes Through Culture with Selected Fishes, W80-06034 5D
Throughfall and Stemflow, W80-06105 2B	BLACKBURN, T. H. Distribution of Oxygen in Marine Sediments	BUMGARDNER, W. H. Public Attitudes Toward the Recreational Use
ARMSTRONG, A. T. Investigation of Groundwater Quality and Its Effect on Suburban Development in Washoe	Measured with Microelectrodes, W80-06117 2L	of Drinking Water Reservoirs in Massachusetts, W80-06157 6B
Valley, Nevada, W80-06005 5A	BLANCHARD, A. S. Relationships Between Heterotrophic Bacteria and Pollution in an Industrialized Estuary,	BUONO, A. Generalized Thickness of the Confining Bed Overlying The Floridan Aquifer, Southwest
ASCH, P. The Incidence of Water Quality: A County Level Analysis,	W80-06126 5B BORDOVSKY, J. P.	Florida Water Management District, W80-06055 7C
W80-06150 5A ASH, D. E.	New Irrigation System Design for Maximizing Irrigation Efficiency and Increasing Rainfall Uti- lization.	BUSCH, J. R. User's Guide to UIMIP and MTRX, W80-06006 7C
M2 Tidal Effects in Greater Cook Strait, New	W80-06003 3F	CHANG, H. H.
Zealand, W80-06123 2L	BORKAR, M. D. Determination of Cerium in Marine Sediments,	Stable Alluvial Canal Design, W80-06129 2E
ASMAN, W. A. H. Draft, Construction and Operation of a Sequential Rain Sampler.	W80-06086 5A BOST, J-F.	CHEN, J. J. Apparatus for the Treatment of Wastewater,
W80-06084 7B	Optimum Management of Water Meters: Ways and Means,	W80-06193 5D
AVELALLEMANT, S. P. Assessment of Sewage Lagoons as Potential Fish	W80-06121 6B	CHENG, A. H. O. Singularities in Darcy Flow Through Porous
Culture Sites in West Central Wisconsin, W80-06076 5D	BOUGHTON, W. C. A Frequency Distribution for Annual Floods, W80-06152 2E	Media, W80-06021 2F
AVRON, M. Movement of Heavy Metals into a Shallow Aquifer by Leakage from Sewage Oxidation	BOWMAN, M. J. M2 Tidal Effects in Greater Cook Strait, New	CHERRY, J. A. A Field Exercise on Ground Water Flow Using Seepage Meters and Mini-Piezometers,
Ponds, W80-06026 5B	Zealand, W80-06123 2L	W80-06014 7E
BACK, W. Major Geochemical Processes in the Evolution	BRADLEY, B. P. The Measurement of Temperature Tolerance:	CHERRY, S. M. Rain Drop Sizes and Rainfall Rate Measured by Dual-Polarization Radar,
of Carbonate-Aquifer Systems, W80-06031 2F	Verification of an Index, W80-06041 2L	W80-06087 7E
BANWART, W. L.	BRADLEY, P.	CHIKWANHA, R.
Sorption of Dibenzothiophene by Soils and Sedi- ments,	Genetic and Physiological Adaptation of the Copepod Eurytemora Affinis to Seasonal Tem-	Laboratory Measurement of Sediment by Turbi dity,
W80-06110 5B	peratures, W80-06038 2L	W80-06127 2
BARBER, F. G. Role of Advective Terms in Tidally Generated	BRADLEY, R. L.	CHIRICO, A. N. Process for Recovery of Chemicals from Saline
Residual Circulation, W80-06136 2L	Polymer to Agglomerate Resolved Emulsions, W80-06065 5D	Water, W80-06176

CHOW, S-L. Analytical-Numerical Computation of Infiltra-	Nutrients and Associated Ion Concentrations in	Water Data and Services Available from Partici-
tion, W80-06196 2G	Irrigation Return Flow From Flooded Rice Fields,	pants in the National Water Data Exchange, W80-06047 10D
CLEAVE, M. L. Potential for Changing Phytoplankton Growth in Lake Powell Due to Oil Shale Development,	W80-06108 5B DEWALLE, F. B. Ground Water Pollution by Septic Tank Drain	ENGLE, C. R. Estrogen Sex Reversal of Tilapia Aurea, W80-06035
W80-06092 5B COLLINS, R. E. Depth Constraints on Thermal Storage Wells, W80-06025 8B	Fields, W80-06023 5G DEWITT, R. E. Water Sprinkler,	FARRAR, C. D. Maps Showing Ground-Water Conditions in the Hopi Area, Coconino and Navajo Counties, Ari- zona-1977, W80-06052 7C
CONTRACTOR, D. N. A Spatially Responsive Hydrologic Model to Predict Erosion and Sediment Transport, W80-06159 2J	W80-06174 3F DIAMANT, B. Z. The Appropriate Technology of Promoting Safe Water Supply in Africa, W80-06119 5F	FAVA, J. A. JR Delayed Behavioral Responses of the Balack- nose Dace (Rhinichthys Atratulus) to Chlora- mines and Free Chlorine,
COOLEY, K. R. Erosivity Values for Individual Design Storms, W80-06195 2J	DICK, R. P. Nutrient and Coliform Losses inRunoff from Fertilized and Sewage Sludge-Treated Soil,	W80-06039 5C FIETERSE, A. J. H. The Phosphorus-Chlorophyll Relationship in
CORNISH, R. 'Saw-Tooth' Moraines in Front of Bodalsbreen, Southern Norway, W80-06100 2C	W80-06109 5B DICKERMAN, D. C. Geohydrologic Data for the Lower Wood River	Roodeplant Dam W80-06037 5C FOK, YU-SI
COTTLE, R. W. Management Model of a Ground Water System with a Transient Pollutant Source,	Ground-Water Reservoir, Rhode Island, W80-06068 7C DICKSON, J. G.	Urbanization-Induced Impacts on Infiltration Capacity and on Rainfall-Runoff Relation in an Hawaiian Urban Area, W80-06078 4C
W80-06015 5G CROLEY, T. E. II A Numerical Model for Computation of Sedi-	Evaluation of Mutagenicity Testing of Extracts from Processed Oil Shale, W80-06009 5A	FOLEY, N. L. Refrigeration Type Water Desalinisation Units, W80-06178 3A
mentation in Lakes and Reservoirs, W80-06012 2J CSANADY, G. T.	Performane of V.H.F. Aerials Close To a Snow Surface, W80-06098	FOLSTER, H. G. Water Treatment for Small Public Supplies, W80-06007 5F
Mean Summer Circulation in Lake Ontario within The Coastal Zone, W80-06188 2H	DOYLE, W. H. Calibration of a Distributed Routing Rainfall- Runoff Model at Four Ruban Sites Near Miami,	FORD, S. A. Irrigation Return Water Impact on Selected Attached Diatoms in the Sacramento River, California,
CUNNINGHAM, J. J. Nitrogen Fixation Associated with Four Species of Submerged Anglosperms in the Central Chesapeake Bay, W80-06040 21	Florida, W80-06060 2A DRACUP, J. A. On the Definition of Droughts,	W80-06080 5C FOREMAN, B. E. Vacuum Sewage System, W80-06181 5D
W80-06040 21 CURTIS, A. A. Numerical Analysis of Infiltration into a Sand Profile Bounded by a Capillary Fringe, W80-06155 2G	W80-06148 2B On the Statistical Characteristics of Drought Events, W80-06147 2B	FORHAM, J. W. Investigation of Groundwater Quality and Its Effect on Suburban Development in Washoe Valley, Nevada,
DAVIES, T. R. H. Bedform Spacing and flow Resistane, W80-06096 2J	Stochastic Parameter Estimation Procedures for Hydrologic Rainfall-Runoff Models: Corrolated and Heteroscedastic Error Cases, W80-06138 2A	FREEZE, R. A. A Stochastic-Conceptual Analysis of Rainfall-Runoff Processes on a Hillslope,
DAWSON, K. I. Evaluation of Jet-Roof Geometry for Snow-Comice Control, W80-06103 2C	DRAKE, J. J. The Effect of Soil Activity on the Chemistry of Carbonate Groundwaters, W80-06142 2K	FROELICH, P. N. Analysis of Organic Carbon in Marine Sediments,
DE VILLIERS, G. DU T. Net Reainfall and Interception Loss in a Savanna Cover (Netto Reenval En Onderskeppingsverlies In 'N Savannabedekking), W80-06091 21	DREICER, M. The Distribution of Mercury, Cesium-137, and Plutonium in an Intermittent Stream at Los Alamos, W80-06106 5B	W80-06133 5A FRYER, J. L. Microbiological Assessment of River Water Contamination by Fish Hatchery Effluent, W80-06083 5G
DELLEUR, J. W. Planning Groundwater Supply Systems for Urban Growth: Applications to West Lafayette, Indiana,	DUNIGAN, E. P. Nutrient and Coliform Losses inRunoff from Fertilized and Sewage Sludge-Treated Soil, W80-06109 5B	FUKUDA, M. K. The Entrainment of Cohesive Sediments in Freshwater, W80-06187 2J
W80-06158 4B DENT, J. D. Forces on Structures Impacted and Enveloped	DURAN, R. Water Treatment for Small Public Supplies, W80-06007 5F	GARDNER, W. R. Dynamic System for Measuring Soil-Moisture Characteristics at Various Temperatures, W80-06077 2G
by Avalanches, W80-06101 2C DESMED, A. Present Methods and Prospectives in Water	DYER, T. G. J. On Some Aspects of Climatology Associated with A Dam, W80-06071 2B	GASS, T. E. Regulatory and Environmental Implications of Ground Water Heat Pumps, W80-06030 6E
Meter Reading and Billing (Methodes Actuelles et Prospectives en Matiere de Releve des Comp- teurs et de Facturation des Consommations d'eau), W80-06120 6B	EATON, J. W. Environmental Contamination Through Residu- al Trace Metal Dispersal from a Derelict Lead- Zinc Mine, W80-06111 5B	GHIRIN, A. Public Attitudes Toward the Recreational Use of Drinking Water Reservoirs in Massachusetts, W80-06157 6B
OD.		

8

GIOVANNELLI, R. F. Regional Flood-Frequency Relations for West Central Florida, W80-06064 2E	HARRITS, S. M. Stratification of Aerobic Methane-Oxidizing Organisms in Lake Mendota, Madison, Wisconsin, W80-06116 2H	JOHNSON, M. J. Classification of Ground-Water Recharge Potential in Three Parts of Santa Cruz County, California,
GLADNEY, E. S. The Distribution of Mercury, Cesium-137, and	HARTIGAN, J. P. Analysis of Non-Point Pollution Export from	W80-06056 4B JOHNSON, M. S.
Plutonium in an Intermittent Stream at Los Alamos, W80-06106 5B	Small Catchments, W80-06090 5B	Environmental Contamination Through Residu- al Trace Metal Dispersal from a Derelict Lead- Zinc Mine,
GODDARD, J. W. F.	HASSETT, J. J.	W80-06111 5B
Rain Drop Sizes and Rainfall Rate Measured by Dual-Polarization Radar,	Sorption of Dibenzothiophene by Soils and Sedi- ments, W80-06110 5B	JONES, M. A. Vacuum Sewage System,
W80-06087 7B	HELD, J. W.	W80-06181 5D
GORELICK, S. M. Management Model of a Ground Water System with a Transient Pollutant Source, W80-06015 5G	Assessment of Sewage Lagoons as Potential Fish Culture Sites in West Central Wisconsin, W80-06076 5D	JONES, S. H. Copper River Hydraulics Study at Million Dollar Bridge, Alaska, W80-06051 8B
GORMAN, M. Performane of V.H.F. Aerials Close To a Snow Surface, W80-06098 2C	HELSEL, D. R. Analysis of Non-Point Pollution Export from Small Catchments, W80-06090 5B	KAELIN, J. R. Method for the Biological Purification of Effluent and the Plant for Carrying Out the Process, W80-06059 5D
GOULDER, R.	HELVEY, J. D.	KAHANOVICH, Y.
Relationships Between Heterotrophic Bacteria and Pollution in an Industrialized Estuary, W80-06126 5B	Effects of Chemical Defoliation of an Abies Grandis Habitat on Amounts and Chemistry of Throughfall and Stemflow, W80-06105 2B	Movement of Heavy Metals into a Shallow Aquifer by Leakage from Sewage Oxidation Ponds, W80-06026 5B
GRIFFIN, D. M. JR.		
Analysis of Non-Point Pollution Export from Small Catchments, W80-06090 5B	HELZ, G. R. Organic-Rich Colloidal Marerial in Estuaries and Its Alteration by Chlorination,	KANEHIRO, B. Y. A Note on the Meaning of Storage Coefficient, W80-06139 2F
GRIZZARD, T, J,	W80-06093 5A	KARIM, F.
Analysis of Non-Point Pollution Export from Small Catchments, W80-06090 5B	HOPKINS, K. D. Estrogen Sex Reversal of Tilapia Aurea, W80-06035 81	A Numerical Model for Computation of Sedi- mentation in Lakes and Reservoirs, W80-06012 2J
		KEASLER, L. C.
GRUBERT, J. P. Estuarine Front Formation and Propagation, W80-06194 2L	HOWITT, R. E. Crop Production and Water Supply Characteristics of Kern County, W80-06082 6C	The Response of Illinois Municipal Water Sys- tems to a Prolonged Period of Drought, W80-06079 2E
Experiments on Arrested Saline Wedge, W80-06128 2L	707 1 77 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	KENNEDY, G. R.
HAKANSSON, L. A. H. Device for Purification of Liquids,	Efficiency and Equity in Management of Agri- cultural Water Supplies, W80-06081 6C	Rain Drop Sizes and Rainfall Rate Measured by Dual-Polarization Radar, W80-06087 7B
W80-06172 5D	HUCK, M. G.	
HAKONSON, T. E. The Distribution of Mercury, Cesium-137, and Plutonium in an Intermittent Stream at Los	An Automated System for Measuring Soil Water Potential Gradients in A Rhizotron Soil Profile,	KENNEDY, J. F. A Numerical Model for Computation of Sedimentation in Lakes and Reservoirs, W80-06012 2J
Alamos,	W80-06185 2G	KHAN, I. A.
W80-06106 5B	HUFFMIRE, M. M.	Ground Water Simulation Using a One Dimen-
HALL, M. P. M. Rain Drop Sizes and Rainfall Rate Measured by Dual-Polarization Radar,	Regulation of Land Use Practices for Areas Surrounding Aquifers - Economic and Legal Implications,	sional Flow Model, W80-06044 7C
W80-06087 7B	W80-06002 6E	KIBBLEWHITE, A. C. M2 Tidal Effects in Greater Cook Strait, New Zealand,
Transference Mechanism of Polychlorinated Bi-	HUFNAL, J. M. JR. Oxidative Polymerization of Dissolved Phenols	W80-06123 2L
phenyl by Aquatic Organisms, W80-06004 5A	by Soluble and Insoluble Inorganic Species, W80-06113 5A	KING, R. M. A Recommendation for the Application of the
HAMILL, L. Evaluation of Induced Infiltration Between the	HUNTER, R. E. Center Pivot Construction for Center Pivot	Roch Index for Slab Avalanche Release, W80-06099 2C
River Skerne and the Magnesian Limestone in South East Durham, W80-06020 4B	Sprinkler, W80-06173 3F	KIRKHAM, D. Seepage Vs. Terrace Density in Reclaimed Min-
HANSHAW, B. B. Major Geochemical Processes in the Evolution	JACKSON, T. J. Profile Soil Moisture from Surface Measure-	eland Soil, W80-06107 2G
of Carbonate-Aquifer Systems, W80-06031 2F	ments, W80-06200 2G	KITCHELL, J. A. Size-Selective Predation, Light Transmission, and Oxygen Stratification: Evidence from the
HANSON, R. S. Stratification of Aerobic Methane-Oxidizing Organisms in Lake Mendota, Madison, Wisconsin,	Runoff Synthesis Using Landsat and SCS Model, W80-06131 2E	Recent Sediments of Manipulated Lakes, W80-06118 2H
W80-06116 2H	JAMES, A. E.	KITCHELL, J. F. Size-Selective Predation, Light Transmission,
HANSON, S. Water Treatment for Small Public Supplies, W80-06007 5F	A Sampler for Cohesive Sediment in the Benthic Boundary Layer, W80-06132 7B	and Oxygen Stratification: Evidence from the Recent Sediments of Manipulated Lakes, W80-06118 2H
HARRELL, J. W. JR	JOHNSON, A. H.	KLAR, L. R. JR.
The Effect of Moisture on Phosphorus Diffusion in Coal Mine Spoils, W80-06186 5C	Trace Metal Budgets for a Forested Watershed in the New Jersey Pine Barrens, W80-06144 5A	Public Attitudes Toward the Recreational Use of Drinking Water Reservoirs in Massachusetts, W80-06157 6B

3

9

8

KNIGHT, A. W. Irrigation Return Water Impact on Selected Attached Diatoms in the Sacramento River, California, W80-06080 5C	Nitrogen Fixation Associated with Four Species of Submerged Anglosperms in the Central Chesapeake Bay, W80-06040 2I	Calibration of a Distributed Routing Rainfall- Runoff Model at Four Ruban Sites Near Miami, Florida, W80-06060 2A
KOHN, J. W. The Impact of Nonstructural Flood Abatement Measures on Patterns of Industrial Location, W80-06011 6F	LIU, P. L-F. Singularities in Darcy Flow Through Porous Media, W80-06021 2F	MILLER, T. L. Water-Quality Data from Five Oregon Stream Ba W80-06067 7C
KOUSKY, V. E. Diurnal Rainfall Variation in Northeast Brazil, W80-06094 2B	LOGANATHAN, G. V. Planning Groundwater Supply Systems for Urban Growth: Applications to West Lafayette, Indiana, W80-06158 4B	MILLER, T. S. Surficial Geology of Pulaski Quadrangle, Oswego County, New York, W80-06062 7C
KOUSSIS, A. D. Analytical-Numerical Computation of Infiltra- tion, W80-06196 2G	W80-06158 4B LOMHOLT, J. P. Distribution of Oxygen in Marine Sediments Measured with Microelectrodes,	MOISAN, J-C. Self-Propelling Watering Apparatus, W80-06177 3F
KOUWEN, N. Biomechanics of Vegetative Channel Linings, W80-06191 2E	W80-06117 2L LONG, A. B. Preliminary Cloud Microphysics Studies for	MONTES, J. S. Singularities in Darcy Flow Through Porous Media, W80-06021 2F
KRAUSE, W. A. System for Electrocatalytic Treatment of Waste Water Streams,	Texas Hiplex 1979, W80-06072 2B LONG, F. L.	MORRELL, G. O. Depth Constraints on Thermal Storage Wells,
W80-06028 5D LAFE, O. E. Singularities in Darcy Flow Through Porous	An Automated System for Measuring Soil Water Potential Gradients in A Rhizotron Soil Profile,	W80-06025 8B MORRIS, E. M. Unsteady One-Dimensional Flow Over a Plane:
Media, W80-06021 2F	W80-06185 2G LUCAS, J. N. The Transport of a Radioactive Salt Through a	Partial Equilibrium and Recession Hydrographs, W80-06153 2E
LANG, T. E. Evaluation of Jet-Roof Geometry for Snow-Cornice Control, W80-06103 2C	Semi-Infinite Column of Porous Medium: A Physical Model, W80-06141 5B	MORTONSON, J. A. Occurrence of A Deep Nitrite Maximum in Lake Michigan, W80-06189 2H
Forces on Structures Impacted and Enveloped by Avalanches, W80-06101 2C	LYLE, W. M. New Irrigation System Design for Maximizing Irrigation Efficiency and Increasing Rainfall Uti- lization,	MUIR, K. S. Classification of Ground-Water Recharge Potential in Three Parts of Santa Cruz County, California,
LARSON, R. A. Oxidative Polymerization of Dissolved Phenols	W80-06003 3F	W80-06056 4E
by Soluble and Insoluble Inorganic Species, W80-06113 5A LATKOVICH, V. J.	MAINI, T. Regional Ground Water Flow Near a High- Level Radioactive Waste Repository, W80-06018 2F	MULLER, E. H. Surficial Geology of Pulaski Quadrangle Oswego County, New York, W80-06062 7C
Flood of July 5-7, 1978, on the South Fork Zumbro River at Rochester, Minnesota, W80-06053 2E	MATHUR, D. Assessment of Thermal Discharges on Zoo- plankton in Conowingo Pond, Pennsylvania, W80-06190 5C	MURABAYASHI, E. T. Urbanization-Induced Impacts on Infiltration Capacity and on Rainfall-Runoff Relation in ar
LEE, D. R. A Field Exercise on Ground Water Flow Using Seepage Meters and Mini-Piezometers, W80-06014 7B	MATTHEWS, J. A. 'Saw-Tooth' Moraines in Front of Bodalsbreen,	Hawaiian Urban Area, W80-06078 4C MURTY, T. S.
LEE, K. S. On the Definition of Droughts, W80-06148 2B	Southern Norway, W80-06100 2C MAUCERI, F. A.	Role of Advective Terms in Tidally Generated Residual Circulation, W80-06136 2L
On the Statistical Characteristics of Drought Events,	Polymer to Agglomerate Resolved Emulsions, W80-06065 5D MCKEE, J. A.	MURTY, V. V. N. Storage of Freshwater in Saline Aquifers, W80-06199 4E
LEONG, J. C. Microbiological Assessment of River Water Contamination by Fish Hatchery Effluent,	Acute Toxicity to Goldfish of Mixtures of Chloramines, Copper, and Linear Alkylate Sulfonate, W80-06042 5A	NACHT, S. J. Flooding Problems in A Small Urban Water shed-Doan Brook, Cleveland, Ohio, W80-06182 2E
W80-06083 5G LEUNG, T. W. K. Demonstration of an Analytic Model for Establishing Water Resources Development Priorities,	MCMULLEN, G. M. Post-Flood Recovery and Hazard Mitigation: Lessons From the Massachusetts Coast, February, 1978, W80-06156 6F	NAKANO, Y. Application of Recent Results in Functiona Analysis to the Problem of Wetting Fronts, W80-06088
W80-06008 6B LI, R-M. Biomechanics of Vegetative Channel Linings,	MEANS, J. C. Sorption of Dibenzothiophene by Soils and Sedi- ments,	NARASIMHAN, T. N. A Note on the Meaning of Storage Coefficient W80-06139 2F
W80-06191 ZE LICK, W. The Entrainment of Cohesive Sediments in Freshwater, W80-06187 2J	W80-06110 5B MILLER, E. E. Dynamic System for Measuring Soil-Moisture Characteristics at Various Temperatures, W80-06077 2G	NEUMAN, S. P. A Statistical Approach to the Inverse Problem of Aquifer Hydrology, 3. Improved Solution Method and Added Perspective, W80-06130
LIGGETT, J. A. Singularities in Darcy Flow Through Porous Media,	MILLER, J. A. Potential Subsurface Zones for Liquid-Waste Storage in Florida,	NICHOLSON, S. E. The nature of Rainfall fluctuations in Subtropical West Africa,
W80-06021 2F	W80-06057 5E	W80-06095 2E

NIMMO, J. R. Dynamic System for Measuring Soil-Moisture Characteristics at Various Temperatures,	PURDY, E. J. JR. Assessment of Thermal Discharges on Zoo- plankton in Conowingo Pond, Pennsylvania,	SAVAGE, E. S. Apparatus for the Treatment of Wastewater, W80-06193 5D
W80-06077 2G NISSENBAUM. A.	W80-06190 5C RAGAN, R. M.	SCHAFF, R. M. Ground Water Pollution by Septic Tank Drain
Movement of Heavy Metals into a Shallow Aquifer by Leakage from Sewage Oxidation	Runoff Synthesis Using Landsat and SCS Model,	Fields, W80-06023 5G
Ponds, W80-06026 5B	W80-06131 2E	SCHULZE, R. E.
NUCKTON, C. F. Crop Production and Water Supply Characteris- tics of Kern County,	RANDALL, C. W. Analysis of Non-Point Pollution Export from Small Catchments, W80-06090 5B	Mapping Potential Evapotranspiration in Hilly Terrain, W80-06069 2D
W80-06082 6C Efficiency and Equity in Management of Agri- cultural Water Supplies,	RAPP, J. R. Effects of Karst and Geologic Structure on the Circulation of Water and Permeability in Car-	SCHWARTZ, F. W. Mass Transport: 1. A Stochastic Analysis of Macroscopic Dispersion, W80-06149 2F
W80-06081 6C NUMAZAWA, R.	bonate Aquifers, W80-06027 2F	SCOTT, J. T.
Process and Apparatus for Waste Water Treat- ment,	REID, G. W.	Mean Summer Circulation in Lake Ontario within The Coastal Zone,
W80-06179 5D	Demonstration of an Analytic Model for Estab- lishing Water Resources Development Priorities,	W80-06188 2H
OCHOA, I. D. Effect of Tail Behavior Assumptions on Flood	W80-06008 6B REITMAN, F. C.	SCOTT, W. S. Occurrence of Salt and Lead in Snow Dump Sites,
Predictions, W80-06154 2E	Regulation of Land Use Practices for Areas Surrounding Aquifers - Economic and Legal	W80-06085 5A
ONISHI, H. Process and Apparatus for Waste Water Treat-	Implications, W80-06002 6E	SEIJO, M. A. Regional Flood-Frequency Relations for West
ment, W80-06179 5D	REMSON, I.	Central Florida, W80-06064 2E
OSTERGREN, I. The Annual Cycle of Plankton Diatom Growth	Management Model of a Ground Water System with a Transient Pollutant Source,	SENECA, J. J. The Incidence of Water Quality: A County
and Silica Production in the Inner Oslofjord, W80-06115	W80-06015 5G REVSBECH, N. P.	Level Analysis, W80-06150 5A
OZTUNALI, O. I. A Model to Assess Migration from Shallow	Distribution of Oxygen in Marine Sediments Measured with Microelectrodes, W80-06117 2L	SHAKESBY, R. A. 'Saw-Tooth' Moraines in Front of Bodalsbreen,
Land Burial Facilities, W80-06019 7C	RICHERSON, P. J. The Effects of Transect Direction on Observed	Southern Norway, W80-06100 2C
PAASCHE, E. The Annual Cycle of Plankton Diatom Growth and Silica Production in the Inner Oslofjord,	Spatial Patterns of Chlorophyll in Lake Tahoe, W80-06135	SHANHOLTZ, V. O. A Spatially Responsive Hydrologic Model to Predict Erosion and Sediment Transport,
W80-06115 2L PAULSON, E. G. JR.	ROBBINS, T. W. Assessment of Thermal Discharges on Zoo-	W80-06159 2J
On the Definition of Droughts, W80-06148 2B	plankton in Conowingo Pond, Pennsylvania, W80-06190 5C	SHEA, E. P. System for Electrocatalytic Treatment of Waste Water Streams,
On the Statistical Characteristics of Drought Events,	ROSENAU, J. C. Water Quality of Florida Springs,	W80-06028 5D
W80-06147 2B	W80-06058 1A	SHELTON, W. L. Estrogen Sex Reversal of Tilapia Aurea,
PEDERSEN, R. R. Forces on Structures Impacted and Enveloped by Avalanches,	ROSS, B. B. A Spatially Responsive Hydrologic Model to Predict Erosion and Sediment Transport,	W80-06035 81 SHEN, H. W.
Ŵ80-06101 2C	W80-06159 2J	Effect of Tail Behavior Assumptions on Floor Predictions,
PHILIP, J. R. Field Heterogeneity: Some Basic Issues,	ROUSE, H. Some Paradoxes in the History of Hydraulics,	W80-06154 2E
W80-06137 2G PIERCE, J. C.	W80-06192 2A RUNCHAL, A. K.	SHOOK, R. C. Center Pivot Construction for Center Pivot Sprinkler.
Water Resource Preservation: Personal Values and Public Support,	Regional Ground Water Flow Near a High- Level Radioactive Waste Repository,	Ŵ80-06173 3F
W80-06043 6B PLATT, R. H.	W80-06018 2F	SIGLEO, A. C. Organic-Rich Colloidal Marerial in Estuaries
Post-Flood Recovery and Hazard Mitigation: Lessons From the Massachusetts Coast, February, 1978,	SAEED, M. The Effect of Moisture on Phosphorus Diffusion in Coal Mine Spoils, W80-06186 5C	and Its Alteration by Chlorination, W80-06093 5A SILVA, P. J.
W80-06156 6F	SAGAR, B.	Geohydrologic Data for the Lower Wood River Ground-Water Reservoir, Rhode Island,
PORCELLA, D. B. Potential for Changing Phytoplankton Growth in Lake Powell Due to Oil Shale Development,	On Jacob's Approximation in Flow Through Porous Media, W80-06143 2F	W80-06068 7C
W80-06092 5B POWELL, T. M.	SALWAY, A. A.	The Impact of Nonstructural Flood Abatemen Measures on Patterns of Industrial Location
The Effects of Transect Direction on Observed Spatial Patterns of Chlorophyll in Lake Tahoe,	Time-Series Modelling of Avalanche Activity from Meteorological Data, W80-06102 2C	W80-06011 6F SINGH, S. P.
W80-06135 2H PRUNTY, L.	SANDERSON, P. L.	Storage of Freshwater in Saline Aquifers, W80-06022 4E
Seepage Vs. Terrace Density in Reclaimed Min- eland Soil,	Relationships Between Heterotrophic Bacteria and Pollution in an Industrialized Estuary, W80-06126 5B	Storage of Freshwater in Saline Aquifers, W80-06199
W80-06107 2G	11 00-00120 JB	

SINGH, S. R. On Jacob's Approximation in Flow Through Porous Media, W80-06143 2F	STREUTKER, A. Tensiometer-Controlled Medium Frequency Topsoil Irrigation: A Technique to Improve Ag- ricultural Water Management,	TURNER, F. T. Nutrients and Associated Ion Concentrations in Irrigation Return Flow From Flooded Rice Fields,
SKAGGS, R. W. Drain Depth and Subirrigation in Layered Soils, W80-06197 3F	W80-06070 3F SU, C. Water Retention Measurement for Soils, W80-06198 2G	W80-06108 5B TURNER, J. F. JR. Regional Flood-Frequency Relations for West Central Florida.
SLACK, L. J. Water Quality of Florida Springs, W80-06058 1A	SUMI, E. Process for Treating Waste Water, W80-06036 5D	W80-06064 2E TUSCHALL, J. R. JR.
SMITH, L. Mass Transport: 1. A Stochastic Analysis of Macroscopic Dispersion, W80-06149 2F	SUMMERFELD, R. A. A Recommendation for the Application of the Roch Index for Slab Avalanche Release,	Characterization of Organic Nitrogen in Natural Waters: Its Molecular Size, Protein Content, and Interactions with Heavy Metals, W80-06114 2H
SMITH, N. P. On the Hydrography of Shelf Waters Off the Centeral Texas Gulf Coast, W80-06183 2L	W80-06099 2C SVARZ, J. J. Removal of Color from Paper Mill Waste Waters,	TYVAND, P. A. Thermohaline Instability in Anisotropic Porous Media, W80-06151 2F
SMITH, S. A Layman's Guide to Iron Bacteria Problems in Wells,	W80-06017 5D SWANSON, K. A. Trace Metal Budgets for a Forested Watershed	VADALI, V. N. M. Storage of Freshwater in Saline Aquifers, W80-06022 4B
W80-06016 5C SNIEDOVICH, M. A Variance-Constrained Reservoir Control	in the New Jersey Pine Barrens, W80-06144 TAKEDA, H. Process and Apparatus for Waste Water Treat-	VAN ES, J. C. The Response of Illinois Municipal Water Sys- tems to a Prolonged Period of Drought, W80-06079 2E
Problem, W80-06145 2H SONNTAG, W. H.	ment, W80-06179 5D	WAGNER, G. H. Chemistry of the Spring Waters of the Ouachita
Water-Quality Data for Canals in Eastern Broward County, Florida, 1975-78, W80-06061 7C	TALAVAGE, J. J. Planning Groundwater Supply Systems for Urban Growth: Applications to West Lafayette,	Mountains Excluding Hot Springs, Arkansas, W80-06010 1A WANG, W.
SORENSEN, J. Distribution of Oxygen in Marine Sediments Measured with Microelectrodes.	Indiana, W80-06158 4B TANG, C. L.	Fractionation of Sediment Oxygen Demand, W80-06125 5A
W80-06117 2L SOROOSHIAN, S.	Mixing and Circulation in the Northwestern Gulf of St. Lawrence: A Study of a Buoyancy- Driven Current System,	WARD, P. R. B. Laboratory Measurement of Sediment by Turbidity,
Stochastic Parameter Estimation Procedures for Hydrologic Rainfall-Runoff Models: Corrolated and Heteroscedastic Error Cases, W80-06138 2A	W80-06122 2L TANG, Y. K. Drain Depth and Subirrigation in Layered Soils, W80-06197 3F	W80-06127 2J WATSON, K. K. Numerical Analysis of Infiltration into a Sand Profile Bounded by a Capillary Fringe,
SPECHLER, R. M. Generalized Configuration of the Bottom of the Floridan Aquifer, Southwest Florida Water Management District, W80-06054 7C	TAYLOR, J. D. Role of Advective Terms in Tidally Generated Residual Circulation, W80-06136 2L	W80-06155 2G WATSON, W. C. Efficiency and Equity in Management of Agricultural Water Supplies, W80-06081 6C
Generalized Thickness of the Confining Bed Overlying The Floridan Aquifer, Southwest Florida Water Management District, W80-06055 7C	TIEDEMANN, A. R. Effects of Chemical Defoliation of an Abies Grandis Habitat on Amounts and Chemistry of Throughfall and Stemflow, W80-06105 2B	WATSON, W. D. Crop Production and Water Supply Characteristics of Kern County, W80-06082 6C
SPRINGFIELD, V. T. Effects of Karst and Geologic Structure on the Circulation of Water and Permeability in Car- bonate Aquifers, W80-06027 2F	TIMCO, G. W. An Analysis of the In-Situ Resistivity of Sea Ice in Terms of Its Microstructure, W80-06104 2C	WETZEL, R. G. Fluorescence: Absorbance RatiosA Molecular Weight Tracer of Dissolved Organic Matter, W80-06134
STAUFFER, R. E. Windpower Time Seris Above a Temperate Lake, W80-06112 2H	TOERIEN, D. F. The Phosphorus-Chlorophyll Relationship in Roodeplaat Dam W80-06037 5C	WHITE, G. C. The Distribution of Mercury, Cesium-137, and Plutonium in an Intermittent Stream at Los Alamos,
STEELE, K. F. Chemistry of the Spring Waters of the Ouachita Mountains Excluding Hot Springs, Arkansas, W80-06010 1A	TOWNSON, J. M. Optimum Spillway Breadth for Gravity Dams, W80-06097 TSAI, CF.	W80-06106 5B WHITTENBARGER, R. L. The Response of Illinois Municipal Water Systems to a Prolonged Period of Drought,
STEVENSON, J. C. Nitrogen Fixation Associated with Four Species of Submerged Anglosperms in the Central Chesapeake Bay,	Acute Toxicity to Goldfish of Mixtures of Chloramines, Copper, and Linear Alkylate Sul- fonate, W80-06042 5A	W80-06079 2E WILLIAMS, D. J. A. A Sampler for Cohesive Sediment in the Benthic Boundary Layer,
W80-06040 21 STEWART, A. J. Fluorescence: Absorbance RatiosA Molecular- Weight Tracer of Dissolved Organic Matter, W80-06134 5B	TSAI, CHU-FA Delayed Behavioral Responses of the Balack- nose Dace (Rhinichthys Atratulus) to Chlora- mines and Free Chlorine, W80-06039 5C	W80-06132 7E WILSON, D. B. Water Treatment for Small Public Supplies, W80-06007 5E
STRELTSAVA-ADAMS, T. D. Fluid Flow in Naturally Fractured Reservoirs, W80-06024 2F	TURGEON, A. Optimal Operation of Multireservoir Power Systems with Stochastic Inflows, W80-06146 2E	WINANT, C. D. Downwelling over the Southern California Shelf, W80-06184 21

8

MI

WOLANSKY, R. M.
Generalized Configuration of the Bottom of the
Floridan Aquifer, Southwest Florida Water
Management District.
W80-06054 7C
Generalized Thickness of the Confining Bed
Overlying The Floridan Aquifer, Southwest
Florida Water Management District,
W80-06055 7C
WOLFBERG, A.
Movement of Heavy Metals into a Shallow
Aquifer by Leakage from Sewage Oxidation
Ponds.
W80-06026 5B
WOOD C C
WOOD, S. G.
Sorption of Dibenzothiophene by Soils and Sedi-
ments,
W80-06110 5B
WOODS, P. F.
Dissolved Oxygen in Intragravel Water of Three
Tributaries to Redwood Creek, Humboldt
County, California,
W80-06066 4C
W 80-00000 4C
WOOLHISER, D. A.
Unsteady One-Dimensional Flow Over a Plane:
Partial Equilibrium and Recession Hydrographs,
W80-06153 2E
W 60-00133
WRIGHT, B.
Relationships Between Heterotrophic Bacteria
and Pollution in an Industrialized Estuary,
W80-06126 5H
VOO E II
YOO, K. H. User's Guide to UIMIP and MTRX.
W80-06006 7C
ZOLLER, W. H.
Organic-Rich Colloidal Marerial in Estuaries
and Its Alteration by Chlorination,
W80-06093 5A
11 00-00073

))

мі

AARHUS UNIV. (DENMARK), INST. OF ECOLOGY AND GENETICS. Distribution of Oxygen in Marine Sediments	CALIFORNIA UNIV., BERKELEY. LAWRENCE BERKELEY LAB.	COMPAGNIE INTERCOMMUNALE BRUXELLOISE DES EAUX (BELGIUM), Present Methods and Prospectives in Water
Measured with Microelectrodes, W80-06117 2L	A Note on the Meaning of Storage Coefficient, W80-06139 2F	Meter Reading and Billing (Methodes Actuelles
	CALIFORNIA UNIV., DAVIS. DEPT. OF	et Prospectives en Matiere de Releve des Comp- teurs et de Facturation des Consommations
ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA, AVONDALE, PA. STROUD	AGRICULTURAL ECONOMICS.	d'eau), W80-06120 6B
WATER RESEARCH CENTER. Oxidative Polymerization of Dissolved Phenols	Efficiency and Equity in Management of Agri- cultural Water Supplies,	CONNECTICUT UNIV., STORRS, INST. OF
by Soluble and Insoluble Inorganic Species,	W80-06081 6C	WATER RESOURCES.
W80-06113 5A	Crop Production and Water Supply Characteris-	Regulation of Land Use Practices for Areas Surrounding Aquifers - Economic and Legal
AEROSPACE CORP., LOS ANGELES, CA. The Entrainment of Cohesive Sediments in	tics of Kern County, W80-06082 6C	Implications, W80-06002 6E
Freshwater, W80-06187 2J		
	CALIFORNIA UNIV., DAVIS. DEPT. OF LAND, AIR, AND WATER RESOURCES.	CONSELHO NACIONAL DE DESENVOLVINENTO CIENTIFICO E
AHMADU BELLO UNIV., ZARIA (NIGERIA). The Appropriate Technology of Promoting Safe	Irrigation Return Water Impact on Selected At-	TECHNOLOGICO, RIO DE JANEIRO (BRAZIL); AND INSTITUTO DE PESQUISAS
Water Supply in Africa, W80-06119 5F	tached Diatoms in the Sacramento River, Cali- fornia,	ESPACIAIS, SAO JOSE DOS CAMPSO
	W80-06080 5C	(BRAZIL). Diurnal Rainfall Variation in Northeast Brazil,
ARIZONA UNIV., TUCSON. DEPT. OF HYDROLOGY AND WATER RESOURCES.	CALIFORNIA UNIV., DAVIS. DIV. OF	W80-06094 2B
A Statistical Approach to the Inverse Problem of Aquifer Hydrology, 3. Improved Solution	ENVIRONMENTAL STUDIES. The Effects of Transect Direction on Observed	CORNELL UNIV., ITHACA, NY. SCHOOL OF
Method and Added Perspective, W80-06130 2F	Spatial Patterns of Chlorophyll in Lake Tahoe, W80-06135 2H	CIVIL AND ENVIRONMENTAL ENGINEERING. Singularities in Darcy Flow Through Porous
ARKANSAS WATER RESOURCES	CALIFORNIA UNIV. LIVERMORE.	Media, W80-06021 2F
RESEARCH CENTER, FAYETTEVILLE. Chemistry of the Spring Waters of the Ouachita	LAWRENCE LIVERMORE LAB. The Transport of a Radioactive Salt Through a	DALTON-DALTON-NEWPORT, SHAKER
Mountains Excluding Hot Springs, Arkansas, W80-06010 1A	Semi-Infinite Column of Porous Medium: A	HEIGHTS, OH.
AUBURN UNIV., AL. DEPT. OF FISHERIES	Physical Model, W80-06141 5B	Flooding Problems in A Small Urban Water- shedDoan Brook, Cleveland, Ohio,
AND ALLIED AQUACULTURES.		W80-06182 2E
Estrogen Sex Reversal of Tilapia Aurea, W80-06035	CALIFORNIA UNIV., LOS ANGELES. SCHOOL OF ENGINEERING AND APPLIED SCIENCE.	DAMES AND MOORE, LOS ANGELES, CA. Regional Ground Water Flow Near a High-
AUSCOTENG PTY LTD., ROSE PARK (AUSTRALIA), (ASSIGNEE).	On the Statistical Characteristics of Drought Events,	Level Radioactive Waste Repository, W80-06018 2F
Refrigeration Type Water Desalinisation Units, W80-06178 3A	W80-06147 2B	A Model to Assess Migration from Shallow
BEDFORD INST. OF OCEANOGRAPHY,	On the Definition of Droughts,	Land Burial Facilities, W80-06019 7C
DARTMOUTH (NOVA SCOTIA). Mixing and Circulation in the Northwestern	W80-06148 2B	DEPARTMENT OF WATER AFFAIRS,
Gulf of St. Lawrence: A Study of a Buoyancy-	CANTERBURY UNIV., CHRISTCHURCH	PRETORIA (SOUTH AFRICA). Water from the Waterskloof,
Driven Current System, W80-06122 2L	(NEW ZEALAND), DEPT. OF AGRICULATURAL ENGINEERING.	W80-06073 8A
BEND RESEARCH, INC., OR.	Bedform Spacing and flow Resistane, W80-06096 2J	DI PALMA IRRIGATION S.A., CAVALLE
Research on Novel Solvent Extraction Systems for Industrial Water Reuse.		Self-Propelling Watering Apparatus,
W80-06032 5D	CASE WESTERN RESERVE UNIV., CLEVELAND, OH. DEPT. OF SYSTEMS	W80-06177 3F
Industrial Water Reuse with Coupled Transport	ENGINEERING.	DRAVO CORP., PITTSBURGH, PA.
Membranes. W80-06033 5D	Stochastic Parameter Estimation Procedures for Hydrologic Rainfall-Runoff Models: Corrolated	Apparatus for the Treatment of Wastewater
BHABHA ATOMIC RESEARCH CENTRE,	and Heteroscedastic Error Cases, W80-06138 2A	W80-06193 5D
BOMBAY (INDIA).		DURBAN-WESTVILLE UNIV. (SOUTH AFRICA)
Determination of Cerium in Marine Sediments, W80-06086 5A	CATALYTIC, INC., PHILADELPHIA, PA. Desalting Handbook for Planners.	Net Reainfall and Interception Loss in a Savan-
BOEING CO., SEATTLE, WA.	W80-06013 3A	Onderskeppingsverlies In 'N Savannabedekk
Forces on Structures Impacted and Enveloped by Avalanches,	COLD REGIONS RESEQUENT AND	ing), W80-06091 2
W80-06101 2C	ENGINEERING LABORATORY, HANOVER, NH.	ECODYNE CORP., LINCOLNSHIRE, IL.
BRITISH ANTARCTIC SURVEY,	Application of Recent Results in Functional	(ASSIGNEE).
CAMBRIDGE (ENGLAND), Performane of V.H.F. Aerials Close To a Snow	Analysis to the Problem of Wetting Fronts, W80-06088	Process for Recovery of Chemicals from Saline Water,
Surface, W80-06098 2C		W80-06176 3A
	Effect of Tail Behavior Assumptions on Flood	FENG CHIA COLL, OF ENGINEERING AND
BRITISH COLUMBIA UNIV., VANCOUVER. DEPT. OF GEOLOGICAL SCIENCES.	Predictions, W80-06154 2F	BUSINESS, TAICHUNG (TAIWAN), DEPT. OF
A Stochastic-Conceptual Analysis of Rainfall Runoff Processes on a Hillslope,	COMMONWEALTH SCIENTIFIC AND	W80-06198 20
W80-06140 2E	INDUSTRIAL RESEARCH ORGANIZATION,	FLORIDA UNIV., GAINESVILLE, DEPT, OF
BURTON MECHANICAL CONTRACTORS, INC., ROCHESTER, IN. (ASSIGNEE).	CANBERRA (AUSTRALIA), DIV. OF ENVIRONMENTAL MECHANICS.	CIVIL ENGINEERING. Analytical-Numerical Computation of Infiltra
Vacuum Sewage System,	Field Heterogeneity: Some Basic Issues,	tion,
W80-06181 5E	W80-06137 2G	W80-06196 2C

FLORIDA UNIV., GAINESVILLE. DEPT. OF ENVIRONMENTAL ENGINEERING SCIENCES.

FLORIDA UNIV., GAINESVILLE, DEPT. OF ENVIRONMENTAL ENGINEERING SCIENCES.	GEOLOGICAL SURVEY, HURON, SD. WATER RESOURCES DIV. Water Resources Data for South Dakota, Water	GEOLOGICAL SURVEY, TALLAHASSEE, FL. WATER RESOURCES DIV. Potential Subsurface Zones for Liquid-Waste
Characterization of Organic Nitrogen in Natural Waters: Its Molecular Size, Protein Content, and	Year 1979, W80-06165 7C	Storage in Florida, W80-06057 5E
Interactions with Heavy Metals, W80-06114 2H	GEOLOGICAL SURVEY, ITHACA, NY. WATER RESOURCES DIV.	Water Quality of Florida Springs, W80-06058 1A
GELOGICAL SURVEY, MADISON, WI.	Surficial Geology of Pulaski Quadrangle,	
WATER RESOURCES DIV. Water Resources Data for Wisconsin, Water	Oswego County, New York, W80-06062 7C	Water-Quality Data for Canals in Eastern Broward County, Florida, 1975-78, W80-06061 7C
Year 1979, W80-06161 7C	GEOLOGICAL SURVEY, LAGUNA NIGUEL, CA. WATER RESOURCES DIV.	Hydrology of Jumper Creek Canal Basin, Sump-
GEOLOGIAL SURVEY, HARTFORD, CT. WATER RESOURCES DIV. Water Resources Data for Connecticut, Water	Generalized Thickness of the Confining Bed Overlying The Floridan Aquifer, Southwest Florida Water Management District,	ter County, Florida, W80-06063 4A
Year 1979,	W80-06055 7C	GEOLOGICAL SURVEY, TALLAHASSES, FL.
W80-06160 7C	GEOLOGICAL SURVEY, LINCOLN, NE. WATER RESOUCES DIV.	WATER RESOURCES DIV. Generalized Configuration of the Bottom of the
GEOLOGICAL SURVEY, ALBANY, NY.	Water Resources Data for Nebraska, Water	Floridan Aquifer, Southwest Florida Water Management District,
WATER RESOURCES DIV. Water Resources Data for New York, Water Year 1979Volum 1. New York Excluding	Year 1979, W80-06162 7C	W80-06054 7C
Long Island,	CROLOGICAL CURVEY MENTO BARY CA	GEOLOGICAL SURVEY, TUCSON, AZ.
W80-06163 7C	GEOLOGICAL SURVEY, MENLO PARK, CA. WATER RESOURCES DIV. Classification of Ground-Water Recharge Poten-	WATER RESOURCES DIV. Maps Showing Ground-Water Conditions in the
Water Resources Data for New York, Water	tial in Three Parts of Santa Cruz County, Cali-	Hopi Area, Coconino and Navajo Counties, Arizona1977.
Year 1979Volume 2. Long Island, W80-06164 7C	fornia, W80-06056 4B	W80-06052 7C
GEOLOGICAL SURVEY, ANCHORAGE, AK.	West Barrier Barrier Galifornia Wasse	GEORGIA UNIV., ATHENS, COLL, OF
WATER RESOURCES DIV. Copper River Hydraulics Study at Million	Water Resources Data for California, Water Year 1978Volume 2. Pacific Slope Basins from Arroyo Grande to Oregon State Line Except	EXPERIMENT STATION. Transference Mechanism of Polychlorinated Bi-
Dollar Bridge, Alaska, W80-06051 8B	Central Valley, W80-06166 7C	phenyl by Aquatic Organisms, W80-06004 5A
CROLOGICAL CURVEY AUCTRA		GRIFFITH UNIV., NATHAN (AUSTRALIA).
GEOLOGICAL SURVEY, AUSTIN, TX. WATER RESOURCES DIV.	Water Resources Data for California, Water Year 1978Volume 3. Sothr Central Valley	SCHOOL OF AUSTRALIAN
Water Resources Data for Texas, Water Year	Basins and the Great Basin from Walker River	ENVIRONMENTAL STUDIES. A Frequency Distribution for Annual Floods,
1978-Volume 1. Arkansas River Basin, Red River Basin, Sabine River Basin, Neches River Basin, Trinity River Basin, and Intervening	to Truckee River, W80-06167 7C	W80-06152 2E
Coastal Basins,	Water Resources Data for California, Water	HARBOR BRANCH FOUNDATION, INC., FORT PIERCE, FL.
W80-06048 7C	Year 1978 Volume 4. Northern Central Valley Basins and the Great Basin from Honey Lake	On the Hydrography of Shelf Waters Off the
Water Resources Data for Texas, Water Year 1978Volume 2. San Jacinto River Basin,	Basin to Oregon State Line, W80-06168 7C	Centeral Texas Gulf Coast, W80-06183 2L
Brazos River Basin, San Bernard River Basin,		HARVANA AGRICULTURAL UNIV., HISSAR
and Intervening Coastal Basins, W80-06049 7C	GEOLOGICAL SURVEY, PORTLAND, OR. WATER RESOURCES DIV. Water-Quality Data from Five Oregon Stream	(INDIA). DEPT. OF AGRICULTURAL ENGINEERING.
Water Resources Data for Texas, Water Year	Ba	Storage of Freshwater in Saline Aquifers, W80-06022 4B
1978Volume 3. Colorado River Basin, Lavaca	W80-06067 7C	
River Basin, Guadalupe River Basin, Nueces River Basin, Rio Grande Basin, and Intervening	GEOLOGICAL SURVEY, PROVIDENCE, RI. WATER RESOURCES DIV.	HARYANA AGRICULTURAL UNIV., HISSAR (INDIA). DEPT. OF AGRICULTURAL
Coastal Basins, W80-06050 7C	Geohydrologic Data for the Lower Wood River Ground-Water Reservoir, Rhode Island,	ENGINEERING. Storage of Freshwater in Saline Aquifers,
GEOLOGICAL SURVEY, BATON ROUGE, LA.	W80-06068 7C	W80-06199 4B
WATER RESOURCES DIV. Water Resources Data for Louisiana, Water	GEOLOGICAL SURVEY, RESTON, VA.	HAWAII UNIV., HONOLULU. WATER
Year 1979Volume 1. Central and Northern	Effects of Karst and Geologic Structure on the Circulation of Water and Permeability in Car-	RESOURCES RESEARCH CENTER. Urbanization-Induced Impacts on Infiltration
Louisiana. W80-06169 7C	honote Aquifers	Capacity and on Rainfall-Runoff Relation in an Hawaiian Urban Area,
Water Resources Data for Louisiana, Water		W80-06078 4C
Year 1979Volume 2. Southern Louisiana. W80-06170 7C	of Carbonate-Aquifer Systems	HOUSTON UNIV., TX. Depth Constraints on Thermal Storage Wells,
Water Resources Data for Loisiana, Water Year	CROLOGICAL CURLENT PROTON, 111	W80-06025 8B
1979Volum 3. Coastal Louisiana. W80-06171 7C	WATER RESOURCES DIV.	HULL UNIV. (ENGLAND), DEPT, OF PLANT BIOLOGY.
GEOLOGICAL SURVEY, BAY ST. LOUIS, MS.	pants in the National Water Data Exchange.	Relationships Between Heterotrophic Bacteria and Pollution in an Industrialized Estuary,
WATER RESOURCES DIV. Calibration of a Distributed Routing Rainfall-		W80-06126 5B
Runoff Model at Four Ruban Sites Near Miami,	WATER RESOURCES DIV.	IBM THOMAS J. WATSON RESEARCH
Florida, W80-06060 2A	and the server at troomeries, manifester,	A Variance-Constrained Reservoir Control
GEOLOGICAL SURVEY, HELENA, MT.	W80-06053 2E	Problem, W80-06145 2H
WATER RESOURCES DIV.	GEOLOGICAL SURVEY, TALLAHASSE, FL.	
Dissolved Oxygen in Intragravel Water of Three Tributaries to Redwood Creek, Humbold		IDAHO UNIV., MOSCOW, DEPT. OF
County, California,	Central Florida,	AGRICULTURAL ENGINEERING. User's Guide to UIMIP and MTRX,
W80-06066 4C		

UMI

NORTH DAKOTA STATE UNIV., FARGO. DEPT. OF AGRONOMY.

URBANA.	CENTER FOR ENVIRONMENTAL AND	(ASSIGNEE).
Water Quality Control and Management of	ESTUARINE STUDIES.	Removal of Color from Paper Mill Waste
Animal Wastes Through Culture with Selected	Delayed Behavioral Responses of the Balack-	Waters,
Fishes, W80-06034 5D	nose Dace (Rhinichthys Atratulus) to Chlora- mines and Free Chlorine,	W80-06017 5D
ILLINOIS STATE WATER SURVEY, PEORIA.	W80-06039 5C	Polymer to Agglomerate Resolved Emulsions,
Fractionation of Sediment Oxygen Demand.	MARYLAND UNIV., BALTIMORE COUNTY,	W80-06065 5D
W80-06125 5A	BALTIMORE. DEPT. OF BIOLOGICAL	NATAL UNIV., PIETERMARITZBURG
ILLINOIS UNIV. AT URBANA-CHAMPAIGN.	SCIENCES. The Measurement of Temperature Tolerance:	(SOUTH AFRIA.)
DEPT. OF AGRICULTURAL ECONOMICS.	Verification of an Index,	Mapping Potential Evapotranspiration in Hilly Terrain.
The Response of Illinois Municipal Water Sys- tems to a Prolonged Period of Drought,	W80-06041 2L	W80-06069 2D
W80-06079 2E	MARYLAND UNIV., BALTIMORE COUNTY,	
ILLINOIS UNIV. AT URBANA-CHAMPAIGN.	CATONSVILLE, DEPT. OF BIOLOGICAL	NATIONAL CENTER FOR ATMOSPHERIC RESEARCH, BOULDER, CO.
DEPT. OF AGRONOMY.	SCIENCES. Genetic and Physiological Adaptation of the	The nature of Rainfall fluctuations in Subtropi-
Sorption of Dibenzothiophene by Soils and Sedi- ments,	Copepod Eurytemora Affinis to Seasonal Tem-	cal West Africa,
W80-06110 5B	peratures, W80-06038 2L	W80-06095 2B
INCREME DE RECHERCE DE L'HUDBO		NATIONAL RESEARCH COUNCIL OF
INSTITUT DE RECHERCE DE L'HYDRO- QUEBEC, VARENNES.	MARYLAND UNIV., COLLEGE PARK. DEPT.	CANADA, VANCOUVER (BRITISH
Optimal Operation of Multireservoir Power Sys-	OF BOTANY. Nitrogen Fixation Associated with Four Species	COLUMBIA). DIV. OF BUILIDING RESEARCH.
tems with Stochastic Inflows, W80-06146 2E	of Submerged Anglosperms in the Central	Time-Series Modelling of Avalanche Activity
W 00-00140	Chesapeake Bay, W80-06040 2I	from Meteorological Data,
INSTITUTE OF HYDROLOGY,	W 80-00040	W80-06102 2C
WALLINGFORD (ENGLAND). Unsteady One-Dimensional Flow Over a Plane:	MARYLAND UNIV., COLLEGE PARK. DEPT.	NATIONAL RESEARCH COUNCIL, OTTAWA
Partial Equilibrium and Recession Hydrographs,	OF CHEMISTRY. Organic-Rich Colloidal Marerial in Estuaries	(ONTARIO), DIV. OF MECHANICAL
W80-06153 2E	and Its Alteration by Chlorination,	ENGINEERING. An Analysis of the In-Situ Resistivity of Sea Ice
INSTITUTE OF OCEAN SCIENCES, SIDNEY	W80-06093 5A	in Terms of Its Microstructure,
(BRITISH COLUMBIA). Role of Advective Terms in Tidally Generated	MARYLAND UNIV., COLLEGE PARK. DEPT.	W80-06104 2C
Residual Circulation,	OF CIVIL ENGINEERING.	NATIONAL WATER WELL ASSOCIATION,
W80-06136 2L	Runoff Synthesis Using Landsat and SCS Model,	WORTHINGTON, OH.
IONICS, INC., WATERTOWN, MA.	W80-06131 2E	A Layman's Guide to Iron Bacteria Problems in
Solar Powered Electrodialysis - Part I: Design	MARYLAND UNIV., SOLOMONS.	Wells, W80-06016 5C
of a Solar Powered Electrodialysis System for Desalting Remote, Brackish Water Sources.	CHESAPEAKE BIOLOGICAL LAB.	
W80-06001 3A	Acute Toxicity to Goldfish of Mixtures of	Regulatory and Environmental Implications of
TOWA UNIV. TOWA CITY	Chloramines, Copper, and Linear Alkylate Sul- fonate,	Ground Water Heat Pumps, W80-06030 6E
IOWA UNIV., IOWA CITY. Some Paradoxes in the History of Hydraulics,	W80-06042 5A	
W80-06192 2A	MASSACHUSETTS UNIV., AMHERST. DEPT.	NAVORSINGSINSTITUUT VIR GROND EN BESPROEIING, PRETORIA (SOUTH
IOWA UNIV., IOWA CITY. INST. OF	OF GEOLOGY AND GEOGRAPHY.	AFRICA).
HYDRAULIC RESEARCH.	Post-Flood Recovery and Hazard Mitigation: Lessons From the Massachusetts Coast, Febru-	Tensiometer-Controlled Medium Frequency
A Numerical Model for Computation of Sedi- mentation in Lakes and Reservoirs,	ary, 1978,	Topsoil Irrigation: A Technique to Improve Ag- ricultural Water Management,
W80-06012 2J	W80-06156 6F	W80-06070 3F
IRRIGATION AND POWER EQUIPMENT,	MASSACHUSETTS UNIV., AMHERST. DEPT.	NAME OF THE OWNER OWNER OF THE OWNER OWN
INC., GREELEY, CO. (ASSIGNEE).	OF LANDSCAPE ARCHITECTURE AND	NEVADA UNIV. SYSTEM, RENO. DESERT RESEARCH INST.
Center Pivot Construction for Center Pivot	REGIONAL PLANNING. Public Attitudes Toward the Recreational Use	Investigation of Groundwater Quality and Its
Sprinkler, W80-06173 3F	of Drinking Water Reservoirs in Massachusetts,	Effect on Suburban Development in Washoe
WAR ARTHUR THURSDAY ARTHUR THE AR	W80-06157 6B	Valley, Nevada, W80-06005 5A
KARADENIZ TEKNIK UNIV., TRABZON (TURKEY), DEPT. OF CIVIL ENGINEERING	MCMASTER UNIV., HAMILTON (ONTARIO).	
AND ARCHITECTURE.	DEPT. OF GEOGRAPHY. The Effect of Soil Activity on the Chemistry of	NEW MEXICO WATER RESOURCES RESEARCH INST., LAS CRUCES.
Flow Net for Unsaturated Infiltration from Peri- odic Strip Sources,	Carbonate Groundwaters,	Water Treatment for Small Public Supplies,
W80-06089 2G	W80-06142 2K	W80-06007 5F
LIVERPOOL UNIV. (ENGLAND), DEPT. OF	MICHIGAN STATE UNIV., HICKORY	NEW SOUTH WALES UNIV., KENSINGTON
BOTANY.	CORNERS, W. K. KELLOGG BIOLOGICAL	(AUSTRALIA); AND ROYAL MILITARY
Environmental Contamination Through Residu-	STATION. Fluorescence: Absorbance RatiosA Molecular-	COLL., DUNTROON (NEW ZEALAND).
al Trace Metal Dispersal from a Derelict Lead- Zinc Mine,	Weight Tracer of Dissolved Organic Matter,	Numerical Analysis of Infiltration into a Sand Profile Bounded by a Capillary Fringe,
W80-06111 5B	W80-06134 5B	W80-06155 20
LOS ALAMOS SCIENTIFIC LAB., NM.	MITSUBISHI RAYON CO. LTD., TOKYO	
ENVIRONMENTAL SCIENCE GROUP.	(JAPAN), (ASSIGNEE),	NORTH CAROLINA STATE UNIV. AT RALEIGH. DEPT. OF BIOLOGICAL AND
The Distribution of Mercury, Cesium-137, and Plutonium in an Intermittent Stream at Los	Process and Apparatus for Waste Water Treat- ment,	AGRICULTURAL ENGINEERING.
Alamos,	W80-06179 5D	Drain Depth and Subirrigation in Layered Soils
W80-06106 5B	MONTANA STATE UNIV., BOZEMAN. DEPT.	W80-06197 31
LOUISIANA STATE UNIV., BATON ROUGE.	OF CIVIL ENGINEERING AND	NORTH DAKOTA STATE UNIV., FARGO.
DEPT. OF AGRONOMY.	ENGINEERING MECHANICS.	DEPT. OF AGRONOMY.
Nutrient and Coliform Losses inRunoff from Fertilized and Sewage Sludge-Treated Soil,	Evaluation of Jet-Roof Geometry for Snow- Cornice Control,	Seepage Vs. Terrace Density in Reclaimed Min eland Soil,
W80-06109 5B	W80-06103 2C	

NORTH DAKOTA STATE UNIV., FARGO. DEPT. OF CIVIL ENGINEERING.

NORTH DAVOTA CTATE INIV. PARCO	PUNJAB AGRICULTURAL UNIV.,	SOCIETE LYONNAISE DES EAUX ET DE
NORTH DAKOTA STATE UNIV., FARGO. DEPT. OF CIVIL ENGINEERING. Analysis of Non-Point Pollution Export from	LUDHIANA (INDIA), DEPT. OF SOIL AND WATER ENGINEERING.	L'ECLAIRAGE (FRANCE). Optimum Management of Water Meters: Ways
Small Catchments,	On Jacob's Approximation in Flow Through	and Means,
W80-06090 5B	Porous Media, W80-06143 2F	W80-06121 6B
NORTH DAKOTA UNIV., GRAND FORKS.		SOCIETE NATIONALE ELF AQUITAINE,
DEPT. OF PHYSICS.	PURDUE UNIV., LAFAYETTE, IN. WATER RESOURCES RESEARCH CENTER.	PARIS (FRANCE). (ASSIGNEE).
The Effect of Moisture on Phosphorus Diffusion	Planning Groundwater Supply Systems for	Removal of Cyanide from Waste Water, W80-06029 5D
in Coal Mine Spoils, W80-06186 5C	Urban Growth: Applications to West Lafayette,	35
	Indiana, W80-06158 4B	STANFORD UNIV., CA. DEPT. OF
NORTH EAST LONDON POLYTECHNIC	W 60-00136	GEOLOGY. Management Model of a Ground Water System
(ENGLAND), DEPT, OF CIVIL ENGINEERING,	RADIATION MANAGEMENT CORP.,	with a Transient Pollutant Source,
Experiments on Arrested Saline Wedge,	DRUMORE, PA. MUDDY RUN ECOLOGICAL LAB.	W80-06015 5G
W80-06128 2L	Assessment of Thermal Discharges on Zoo-	STATE UNIV. OF NEW YORK AT STONY
Estuarine Front Formation and Propagation,	plankton in Conowingo Pond, Pennsylvania, W80-06190 5C	BROOK. MARINE SCIENCES RESEARCH
W80-06194 2L	W 80-06190	CENTER.
OKLAHOMA UNIV., NORMAN. BUREAU OF	RHODE ISLAND UNIV., KINGSTON.	M2 Tidal Effects in Greater Cook Strait, New Zealand.
WATER AND ENVIRONMENTAL	GRADUATE SCHOOL OF OCEANOGRAPHY. Analysis of Organic Carbon in Marine Sedi-	W80-06123 2L
RESOURCES RESEARCH.	ments,	
Demonstration of an Analytic Model for Estab- lishing Water Resources Development Priorities,	W80-06133 5A	SUMITOMO DUREZ CO. LTD., TOKYO (JAPAN). (ASIGNEE).
W80-06008 6B	RICE UNIV., HOUSTON, TX. DEPT. OF	Process for Treating Waste Water,
	GEOLOGY.	W80-06036 5D
OMNIPURE, INC., HOUSTON, TX. (ASSIGNEE).	Fluid Flow in Naturally Fractured Reservoirs, W80-06024 2F	TEXAS A AND M UNIV., COLLEGE
System for Electrocatalytic Treatment of Waste	W 80-00024 2F	STATION, DEPT. OF METEOROLOGY,
Water Streams,	ROCKY MOUNTAN FOREST AND RANGE	Preliminary Cloud Microphysics Studies for
W80-06028 5D	EXPERIMENT STATION, FORT COLLINS, CO.	Texas Hiplex 1979, W80-06072 2B
ONTARIO HYDROLOGY, TORONTO. DEPT.	A Recommendation for the Application of the	W 80-00072
OF TRANSMISSION ENVIRONMENT.	Roch Index for Slab Avalanche Release,	TEXAS A AND M UNIV., LUBBOCK.
Occurrence of Salt and Lead in Snow Dump	W80-06099 2C	AGRICULTURAL RESEARCH AND EXTENSION CENTER.
Sites, W80-06085 5A	RUTGERS - THE STATE UNIV., NEW	New Irrigation System Design for Maximizing
	BRUNSWICK, NJ. DEPT. OF ECONOMICS. The Incidence of Water Quality: A County	Irrigation Efficiency and Increasing Rainfall Uti-
OREGON STATE UNIV., CORVALLIS. WATER RESOURCES RESEARCH INST.	Level Analysis,	lization, W80-06003 3F
Microbiological Assessment of River Water	W80-06150 5A	W 80-00003
Contamination by Fish Hatchery Effluent,	RUTHRFORD AND APPLETON LAB.,	TEXAS AGRICULTURAL EXPERIMENT
W80-06083 5G	SLOUGH (ENGLAND).	STATION, BEAUMONT. Nutrients and Associated Ion Concentrations in
OSLO UNIV. (NORWAY). DEPT. OF MARINE	Rain Drop Sizes and Rainfall Rate Measured by Dual-Polarization Radar,	Irrigation Return Flow From Flooded Rice
BIOLOGY AND LIMNOLOGY.	W80-06087 7B	Fields,
The Annual Cycle of Plankton Diatom Growth and Silica Production in the Inner Oslofjord,	CAN DIEGO CTATE UNIV. CA DEPT OF	W80-06108 5B
W80-06115 2L	SAN DIEGO STATE UNIV., CA. DEPT. OF CIVIL ENGINEERING.	UNION CARBIDE CORP., NEW YORK.
OSLO UNIV. (NORWAY), DEPT, OF	Stable Alluvial Canal Design,	(ASSIGNEE).
MATHEMATICS,	W80-06129 2E	Method for the Biological Purification of Efflu- ent and the Plant for Carrying Out the Process,
Thermohaline Instability in Anisotropic Porous	SCIENCE AND EDUCATION	W80-06059 5D
Media, W80-06151 2F	ADMINISTRATION, AUBURN, AL. An Automated System for Measuring Soil	UNIVERSITY COLL CARRIES WALES
25	Water Potential Gradients in A Rhizotron Soil	UNIVERSITY COLL., CARDIFF (WALES). DEPT. OF GEOLOGY.
PACIFIC NORTHWEST FOREST AND	Profile,	'Saw-Tooth' Moraines in Front of Bodalsbreen,
RANGE EXPERIMENT STATION, WENATCHEE, WA.	W80-06185 2G	Southern Norway, W80-06100 2C
Effects of Chemical Defoliation of an Abies	SCIENCE AND EDUCATION	
Grandis Habitat on Amounts and Chemistry of	ADMINISTRATION, BELTSVILLE, MD. HYDROLOGY LAB.	UNIVERSITY COLL. OF SWANSEA (WALES).
Throughfall and Stemflow, W80-06105 2B	Profile Soil Moisture from Surface Measure-	DEPT. OF CHEMICAL ENGINEERING. A Sampler for Cohesive Sediment in the Benthic
	ments, W80-06200 2G	Boundary Layer,
PENNSYLVANIA UNIV., PA. DEPT. OF GEOLOGY.	W80-06200 2G	W80-06132 7B
Trace Metal Budgets for a Forested Watershed	SCIENCE AND EDUCATION	UNIVERSITY OF STRATHCLYDE, GLASGOW
in the New Jersey Pine Barrens,	ADMINISTRATION, BOISE, ID. Erosivity Values for Individual Design Storms,	(SCOTLAND), DEPT, OF CIVIL
W80-06144 5A	W80-06195 2J	ENGINEERING. Optimum Spillway Breadth for Gravity Dams,
PLYMOUTH POLYTECHNIC (ENGLAND).	SCRIPPS INSTITUTION OF	W80-06097 2H
DEPT. OF CIVIL ENGINEERING.	OCEANOGRAPHY, LA JOLLA, CA.	THE AND THE CAPT I AVE CITY DEPT OF
Evaluation of Induced Infiltration Between the River Skerne and the Magnesian Limestone in		UTAH UNIV., SALT LAKE CITY. DEPT. OF GEOLOGY AND GEOPHYSICS.
South East Durham,	W80-06184 2L	Mass Transport: 1. A Stochastic Analysis of
W80-06020 4B		Macroscopic Dispersion, W80-06149 2F
PRETORIA UNIV., (SOUTH AFRICA). DEPT.	SHIPPENSBURG STATE COLL., PA. DEPT. OF ECONOMICS AND MANAGEMENT	
OF BOTANY.	SCIENCE.	UTAH WATER RESEARCH LAB, LOGAN.
The Phosphorus-Chlorophyll Relationship in Roodeplaat Dam	The Impact of Nonstructural Flood Abatement Measures on Patterns of Industrial Location,	Evaluation of Mutagenicity Testing of Extracts from Processed Oil Shale.
W80-06037 5C		W80-06009 5A

9

UMI.

YOUNGSTOWN STATE UNIV., OH. DEPT. OF CIVIL ENGINEERING.

Potential for Changing Phytoplankton Growth in Lake Powell Due to Oil Shale Development, W80-06092 5B	F
UTRECHT RIJKSUNIVERSITEIT	
(NETHERLANDS), INST. VOOR	
METEOROLOGIE EN OCEANOGRAFIE.	W
Draft, Construction and Operation of a Sequen-	(S
tial Rain Sampler, W80-06084 7B	
W 80-00064 /B	
VIRGINIA POLYTECHNIC INST. AND STATE	
UNIV., BLACKSBURG. DEPT. OF	W
AGRICULTURAL ENGINEERING.	I
A Spatially Responsive Hydrologic Model to Predict Erosion and Sediment Transport,	
W80-06159 2J	
VOLCANI INST. OF AGRICULTURAL RESEARCH, BET-DAGAN (ISRAEL). INST. OF	Y
SOIL AND WATER,	0
Movement of Heavy Metals into a Shallow	
Aquifer by Leakage from Sewage Oxidation	
Ponds, W80-06026 5B	
75	
WASHINGTON STATE UNIV., PULLMAN.	
DEPT. OF POLITICAL SCIENCE. Water Resource Preservation: Personal Values	
and Public Support,	
W80-06043 6B	
WASHINGTON UNIV., SEATTLE, DEPT. OF	
ENVIRONMENTAL HEALTH.	
Ground Water Pollution by Septic Tank Drain	
Fields, W80-06023 5G	
W 80-00023	
WATERLOO UNIV. (ONTARIO). DEPT. OF	
CIVIL ENGINEERING.	
Biomechanics of Vegetative Channel Linings, W80-06191 2E	
WATERLOO UNIV. (ONTARIO). DEPT. OF	
EARTH SCIENCES.	
A Field Exercise on Ground Water Flow Using Seepage Meters and Mini-Piezometers,	
W80-06014 7B	
WESTERN CANADA HYDRAULIC LABS. LTD. (BRITISH COLUMBIA).	
Laboratory Measurement of Sediment by Turbi-	
dity,	
W80-06127 2J	
WISCONSIN UNIVLACROSSE, DEPT. OF	
BIOLOGY. Assessment of Sewage Lagoons as Potential Fish	
Culture Sites in West Central Wisconsin,	
W80-06076 5D	•
WISCONSIN UNIVMADISON.	
Dynamic System for Measuring Soil-Moisture	•
Characteristics at Various Temperatures,	
W80-06077 2C	i
WISCONSIN UNIVMADISON. DEPT. OF	
Stratification of Aerobic Methane-Oxidizing Or	
ganisms in Lake Mendota, Madison, Wisconsin	
W80-06116 2F	1
WISCONSIN UNIVMADISON, DEPT. OF	
GEOLOGY AND GEOPHYSICS.	
Size-Selective Predation, Light Transmission	
and Oxygen Stratification: Evidence from the	е
Recent Sediments of Manipulated Lakes, W80-06118 21	
	1
	1
WISCONSIN UNIVMADISON, WATER	1
WISCONSIN UNIVMADISON. WATER CHEMISTRY LAB.	
WISCONSIN UNIVMADISON, WATER	e

	WISCONSIN UNIV., MILWAUKEE. CENTER
	FOR GREAT LAKES STUDIES.
	Occurrence of A Deep Nitrite Maximum in
	Lake Michigan,
	W80-06189 2H
	WITWATERSRAND UNIV., JOHANNESBURG
	(SOUTH AFRICA).
	On Some Aspects of Climatology Associated
	with A Dam.
	W80-06071 2B
	W 60-000/1
	WOODS HOLE OCEANOGRAPHIC
	INSTITUTION, MA.
1	Mean Summer Circulation in Lake Ontario
	within The Coastal Zone,
	W80-06188 2H
	VOLINGSTOWN STATE UNIV OH DEPT

C 1

8 0

ACCESSION NUMBER INDEX

W80-06001	3A	
W80-06002	6E	
W80-06003	3F	
W80-06004	5A	
W80-06005	5A	
W80-06006	7C	
W80-06007	5F	
W80-06008	6B	
W80-06009	5A	
W80-06010	1A	
W80-06011	6F	
W80-06012	2J	
W80-06013	3A	
W80-06014	7B	
W80-06015	5G	
W80-06016	5C	
W80-06017	5D	
W80-06018	2F	
W80-06019	7C	
W80-06020	4B	
W80-06021	2F	
W80-06022	4B	
W80-06023	5G	
W80-06024	2F	
W80-06025	8B	
W80-06026	5B	
W80-06027	2F	
W80-06028 W80-06029	5D	
W80-06029	5D	
W80-06030	6E	
W80-06031	2F	
W80-06032	5D	
W80-06033	5D	
W80-06034	5D	
W80-06035	81	
W80-06036	5D	
W80-06037	5C	
W80-06038	2L	
W80-06039	5C	
W80-06040	21	
W80-06041	2L	
W80-06042	5A	
W80-06043	6B	
W80-06044	7C	
W80-06045	7B	
W80-06046	8A	
W80-06047	10D	
W80-06048	7C	
W80-06049	7C	
W80-06050	7C	
W80-06051	8B	
W80-06052	7C	
W80-06053	2E	
W80-06054	7C	
W80-06055	7C	
W80-06056	4B	
W80-06057	5E	
W80-06058	1A	
W80-06059	5D	
	2A	
W80-06060		
W80-06061	7C	
W80-06062	7C	
W80-06063	4A	
W80-06064	2E	
W80-06065	5D	
W80-06066	4C	
W80-06067	7C	
W80-06068	7C	
W80-06069	2D	
W80-06070	3F	
W80-06071	2B	
W80-06072	2B	
W80-06073	8A	
W80-06074	4A	
W80-06075	8E	
W80-06076	5D	
W80-06077	2G	
W80-06078	4C	
W80-06079	2E	
W80-06080	5C	
44 00-0008U	6C	
W80-06081		
W80-06082		
	6C	
W80-06082		
W80-06083	6C 5G	
	6C	

13/00 06005	5A
W80-06085 W80-06086	5A
W80-06087	7B
W80-06088	2G
W80-06089	2G
W80-06090	5B
W80-06091 W80-06092	2I 5B
W80-06093	5A
W80_06094	2B
W80-06095	2B
W80-06096 W80-06097	2J
W80-06097 W80-06098	2H 2C
W80-06099	2C
W80-06100	2C
W80-06101	2C
W80-06102 W80-06103 W80-06104	2C 2C
W80-06103	2C
33700 06106	2B
11700 06106	5B
W80-06107	2G
W80-06107 W80-06108 W80-06109	5B
W80-06110 W80-06111	5B
W80-06112	2H
W80-06114 W80-06115	2H
W80-06115	2L
W80-06116 W80-06117 W80-06118	2H
W80-06118	2H
WX0-06119	5F
W 80-00120	OB
W80-06121	6B
W80-06122 W80-06123	2L 2L
W80-06124	5G
W 90-00173	3A
W80-06126 W80-06127	5B
W80-06127 W80-06128	2J
W80-06128 W80-06129	2L 2F
W80-06130	2E 2F
W80-06130 W80-06131	2E 7B
W80-06132	7B
W80-06133	5A 5B
W80-06134 W80-06135	2H
W80-06136	2L
W80-06137	20
W80-06138	2A
W80-06139 W80-06140	2F 2E
W80-06141	SB
W80-06142	2K
W80-06142 W80-06143 W80-06144	2F
W80-06144 W80-06145	5A
W80-06145 W80-06146	2H 2E
W80-06147	210
33700 06140	272
W80-06149	21
W 80-06130	JA.
W80-06151	2F
W80-06152 W80-06153	2E 2E
W80-06154	2E
W80-06155	2G
W80-06155 W80-06156	6F
W80-06157	6B
W80-06158 W80-06159	4B 2J
W80-06160	7C
W80-06161	7C
W80-06162	7C
W80-06163	7C
W80-06164 W80-06165	7C
W80-06166	7C
W80-06167	7C
W80-06168	7C

W80-06169	7C
W80-06170	7C
W80-06171	7C
W80-06172	5D
W80-06173	3F
W80-06174	3F
W80-06175	3F
W80-06176	3A
W80-06177	3F
W80-06178	3A
W80-06179	5D
W80-06180	5F
W80-06181	5D
W80-06182	2E
W80-06183	2L
W80-06184	2L
W80-06185	2G
W80-06186	5C
W80-06187	2Ј
W80-06188	2H
W80-06189	2H
W80-06190	5C
W80-06191	2E
W80-06192	2A
W80-06193	5D
W80-06194	2L
W80-06195	2.3
W80-06196	2G
W80-06197	3F
W80-06198	2G
W80-06199	4B
W80-06200	2G

8 0 м і

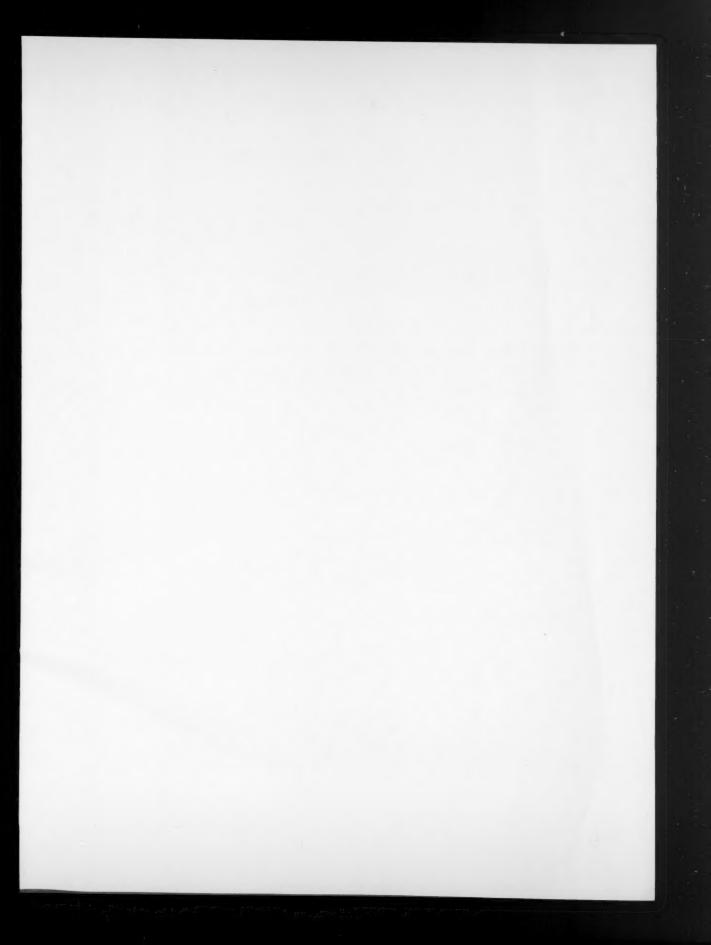
ABSTRACT SOURCES

SOURCE		ACCESSION NUMBER	TOTAL
Α.	CENTERS OF COMPETENCE		
	Illinois State Water Survey, Hydrology	W80-0608406090 0609206118 0612206123 0612506155 0618206192 0619406200	85
	National Water Well Association, Water Well Construction Technology	W80-0601406016 0601806027 0603006031 0604406046	18
	University of Wisconsin, Water Resources Economics	W80-06043	1
В.	STATE WATER RESOURCES RESEARCH INSTITUTES	W80-0600206005 0601106012 0603406035 0603806041 0607606082 0615606159	23
C.	OTHER		
	Environmental Information Services, Inc. (Effects of Pollutants on Aquatic Life)	W80-06042	1
	Information Planning Associates, Inc.	W80-0600606010 06037 0606906075 06091 0611906121	17
	Ocean Engineering Information Service (Patents)	W80-06017, 06124 0602806029 06036, 06059 06065 0617206181 06193	18

ABSTRACT SOURCES

sou	IRCE	ACCESSION NUMBER	TOTAL
C.	OTHER (Continued)		
	Office of Water Research and Technology	W80-06001, 06013 0603206033 06083	5
	U. S. Geological Survey	W80-0604706058 0606006064 0606606068 0616006171	32

UMI



Subject Fields

NATURE OF WATER

WATER CYCLE

WATER SUPPLY AUGMENTATION AND CONSERVATION

WATER QUANTITY MANAGEMENT AND CONTROL

WATER QUALITY MANAGEMENT AND PROTECTION

WATER RESOURCES PLANNING

RESOURCES DATA

ENGINEERING WORKS

MANPOWER, GRANTS, AND **FACILITIES**

SCIENTIFIC AND TECHNICAL INFORMATION

U.S. DEPARTMENT OF COMMERCE National Technical Information Service 5.285 Por Royal Road Springfield, VA 22161

PRINTED MATTER OFFICIAL BUSINESS

EQUAL OPPORTUNITY EMPLOYER

POSTAGE AND FEES PAID
U.S DEPARTMENT OF COMMERCE Special Fourth-Class Rate Book COM 211

SWAN MICROFILMS INTL XBIDBBI.

TOO

INDEXES

UMI

SUBJECT INDEX

AUTHOR INDEX

ORGANIZATIONAL INDEX

ACCESSSION NUMBER INDEX

ABSTRACT SOURCES

Customers in Conside, U.S., and Maxico please use this price schedule; other addressess write for Folder PR-360-4. NORTH AMERICAN CONTINENT PRICE SCHEDULE

110.00 125.00 300.00 300.00 420.00 420.00 540.00 660.00 660.00 660.00 720.00 840.00 960.00 1,080.00 1,200.00 6.50 6.50 8.50 11.

*Contact NTIS for price quote 30.00

